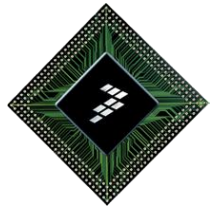
August, 2010

# Demo of Freescale's i.MX51 Linux® Package (Part 2)

ENT-F0951



John Li & Maggie Jiang

**Field Applications Engineer**

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# Session Objectives

- Expectations:

  - Locate important files and documentation
  - Understand tools Freescale offers for i.MX processors
  - Learn about Bootloaders and customization
  - Setup and deploy a Linux system to i.MX
  - Take advantage of Multimedia Acceleration
  - Learn about Ubuntu and Android on i.MX

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# Agenda

1. Introduction
2. Downloads/Files from Web
3. MCIMX51EVK Overview/Capabilities
4. Linux Host Setup
5. Tools
6. Bootloaders
7. Building and Deploying Linux Using LTIB
   - Gstreamer for Multimedia
   - GPU SDK
8. Ubuntu on Target
9. Android on Target
10. Questions?

(If Time Allows)

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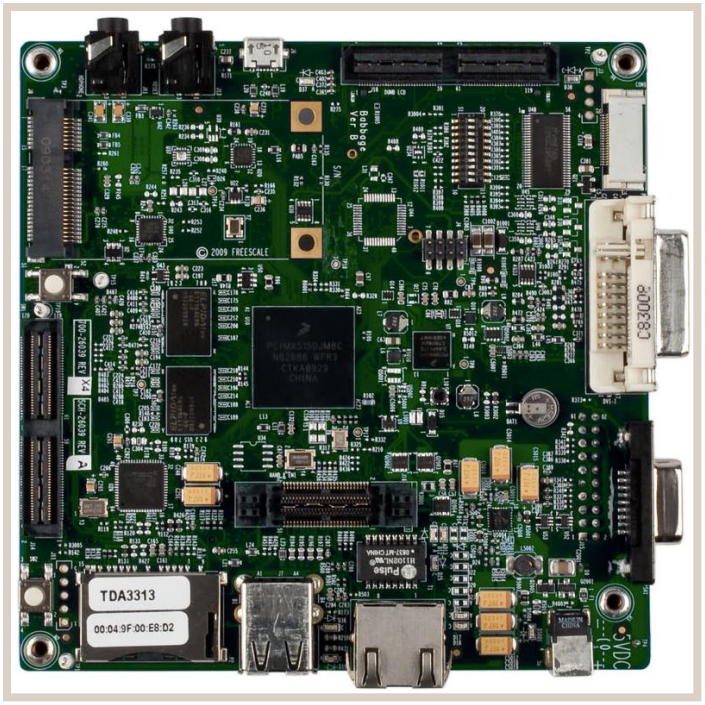
# System Setup

- MCIMX51EVKJ




- Connected to DVI monitor
- Vmware Player (Free) running in Windows
- UBUNTU 10.04 Image with Freescale iMX L2.6.31_10.07.11 SDK Installed
- Serial connected to Laptop @115200
- Ethernet between laptop and i.MX51 (Auto MDIX)
- 4GB SD CARD
- SDHC Card Reader

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# i.MX51 Evaluation Kit (EVK) – $699 Resale

## Single Board Development Platform – Price, Performance, Personality

### i.MX51 Evaluation Kit Features

- i.MX51 Applications Processor (529 BGA)
- 4 x 128MB DDR2
- 4MB SPI NOR
- PMIC – Atlas APL (MC13892JV or MC13892JVL)
- NAND and EIM Header
- Debug Serial Port
- JTAG
- Reset, boot switches
- Debug LED
- Power Source
- Power on/off button
- Power Measurement Header
- 7” WVGA Touchscreen LCD Display (add-on module)
- Expansion board (add-on module)
- 2 LVDS connectors
- DVI-I connector
- 2 SD/MMC Card Slots
- USB Host x2/USB OTG x1
- Ethernet Port
- Mini PCIe
- SATA HDD connector
- SIM Card connector
- Keyboard connector
- Mic input, stereo headphone output (jack), V2IP Headphone
- Speaker connector
- USB Camera connector
- PS-2 TP connector
- RGB output through DVI-I connector
- Expansion Header
- Ambient light sensor footprint
- FM receiver footprint

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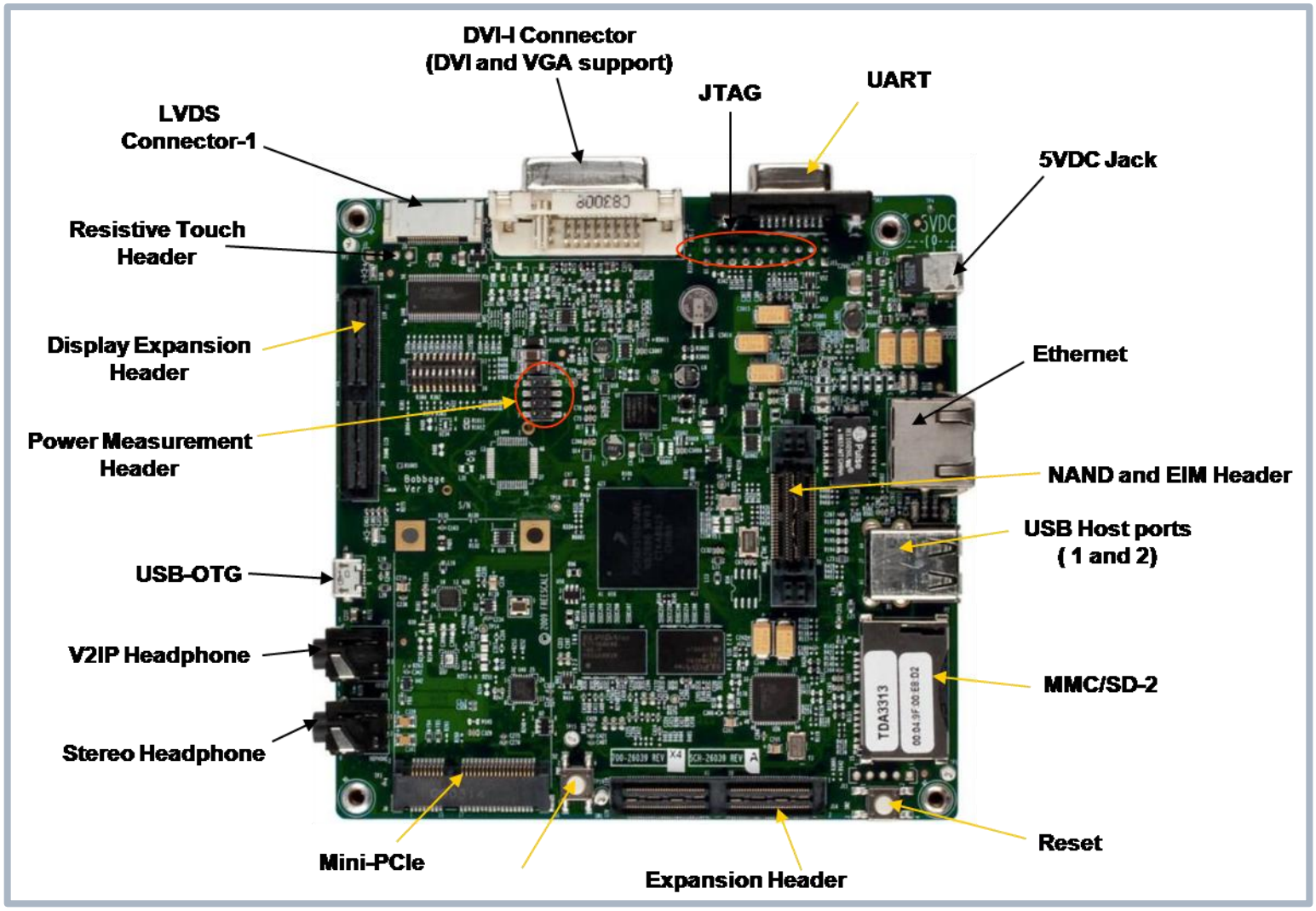
# MCIMX51EVKJ Features

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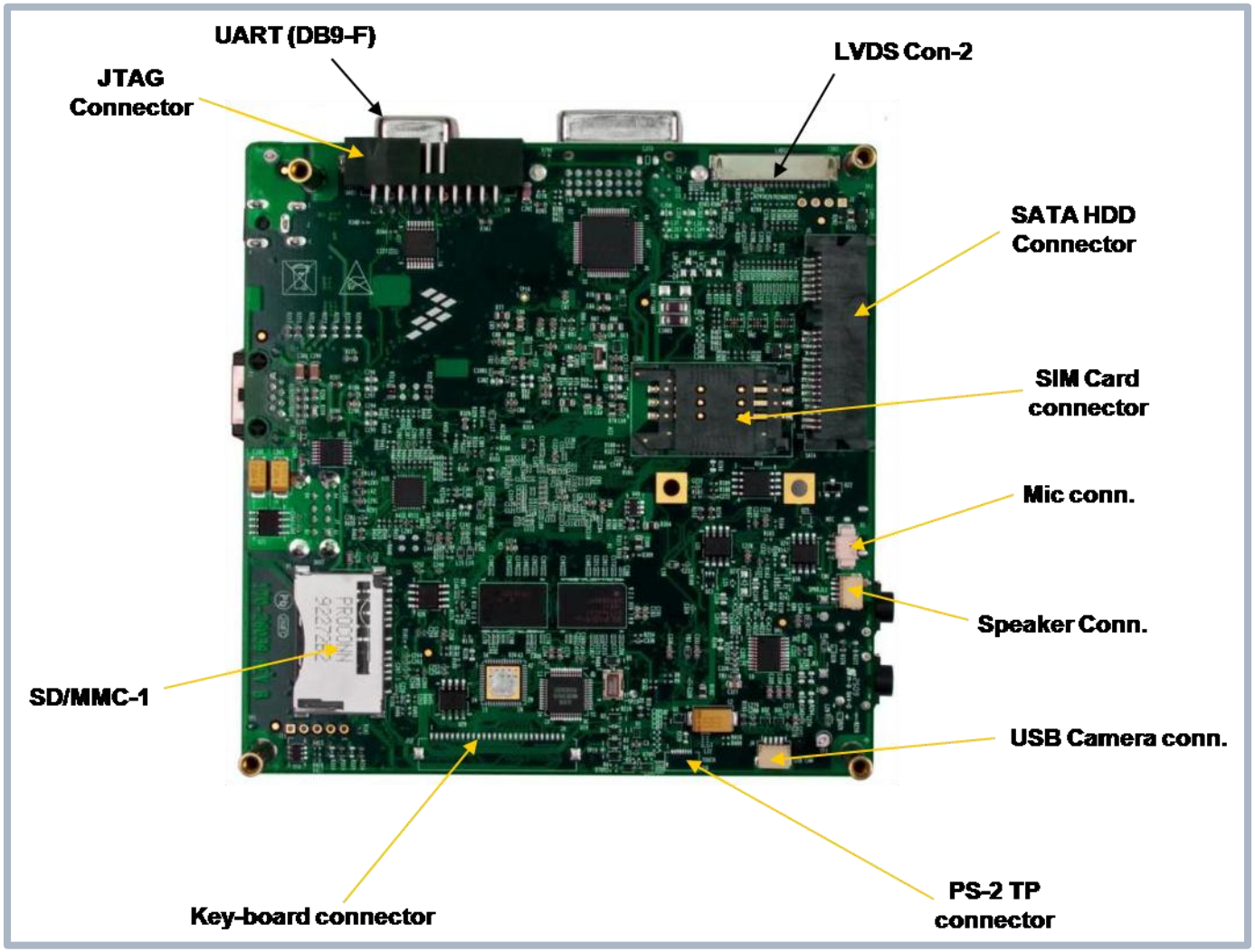
# MCIMX51EVKJ Features

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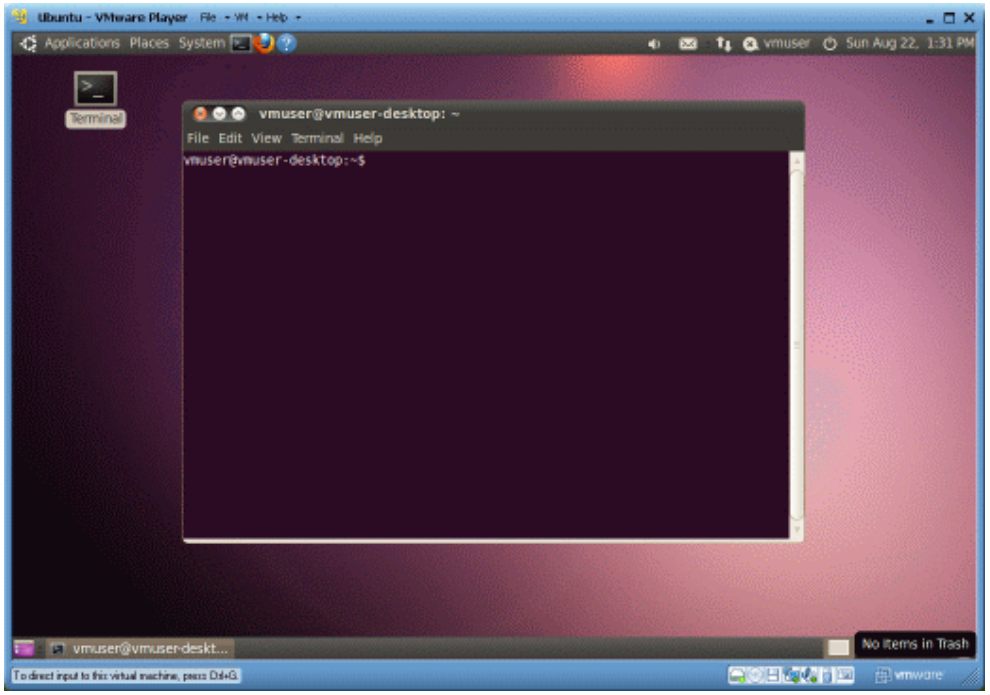
# Station Setup

- Running Ubuntu 10.04
  - Username = vmuser
  - Password = vmuser
- Image Created using Vmplayer (Free) 3.0.1
- Running under Vmware Player (Free) 3.0.1
- Have “Vmware-Tools” installed, which allows dragging and dropping from Windows to Linux as well as shared folders between the two OS’s
- Development board (i.MX51 EVK) connected Directly to Laptop via Ethernet
- i.MX51 EVK connected to DVI monitor

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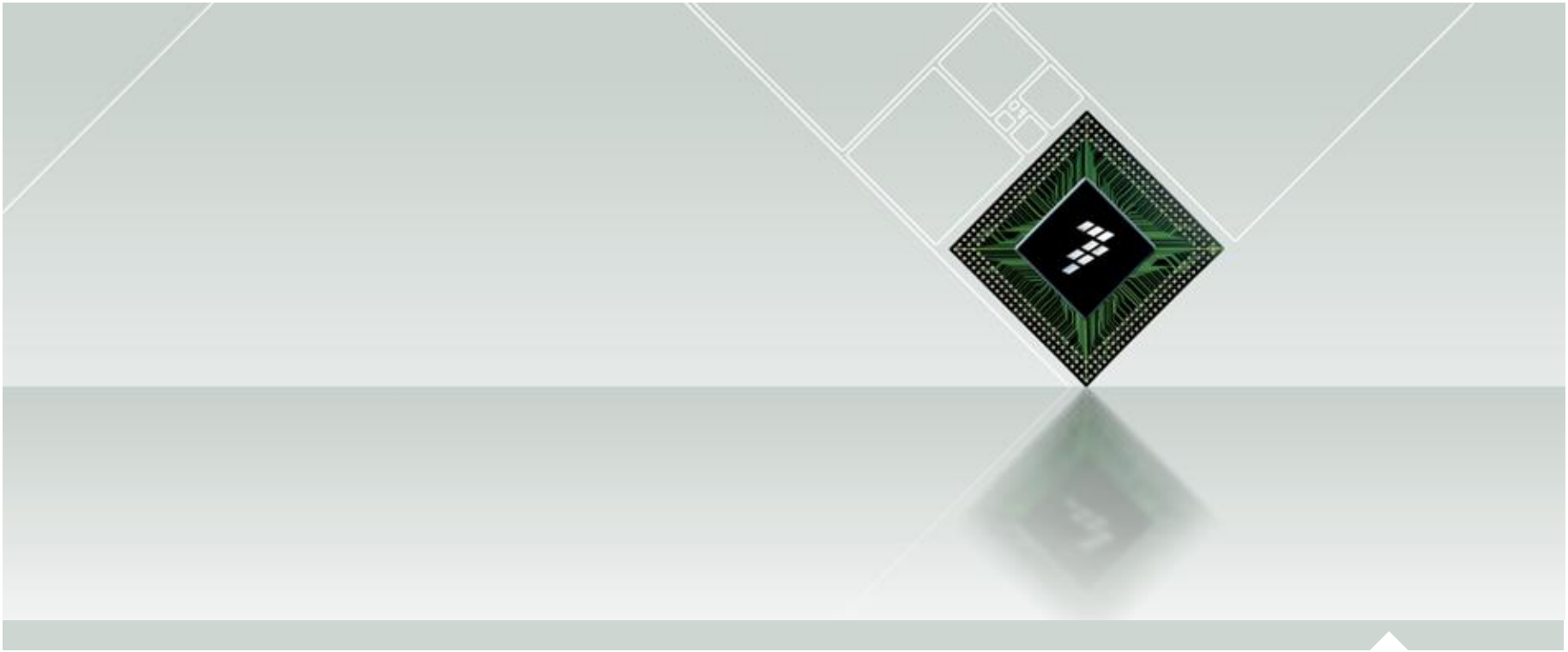

# Important Files/Downloads

Walk-through of Freescale's i.MX Web

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# i.MX Web Resource

- http://www.freescale.com/imx

http://www.freescale.com/webapp/sps/site/homepage.jsp?code=IMX_HOME&tid=vanimx
File Edit View Favorites Tools Help
i.MX Applications Processors
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Contact Us Worldwide: United States | 中国 | 日本語 | 한국어 | Login My Freescale
Products Applications Technologies Support Buy About Freescale
Enter Part Number
Enter Keyword
Welcome Guest Register or Login Annotate this Page Browse History My Recommendations Why Should I Register? Page Actions
Freescale ▸ i.MX Applications Processors
i.MX Applications Processors
Freescale ARM-based i.MX multimedia applications processors deliver an optimal balance of performance and long battery life for rich multimedia experiences on the go. The i.MX applications processor family includes processors based on ARM9, ARM11 and ARM™ Cortex-A8 core technologies, which are powering new applications in consumer, automotive and industrial markets that demand exceptional performance and efficiency.
The i.MX family is part of Freescale's Energy Efficient Solutions.
Products
i.MX Product Selector
Parametric Search
i.MX Applications Processors by Family
i.MX21 Processors
i.MX23 Processors
i.MX25 Processors
i.MX27 Processors
i.MX31 Processors
i.MX35 Processors
i.MX37 Processors
i.MX50 Processors
i.MX51 Processors
i.MX53 Processors
i.MXS Processors
i.MX Software and Development Tools
Android
Linux
Windows Embedded
i.MX Applications Processors by Applications
Automotive
Consumer
Medical
Design Resources
Getting Started
Design Help
Virtual Customer Experience Center
Introducing the i.MX535 for Tablets and Smart Mobile Devices
Optimized for a wide range of operating systems, plus HD 1080p video playback and hardware-accelerated Adobe® Flash® 10.1, the i.MX535 offers a full hardware and software solution to design next-generation consumer devices.
Meet the new i.MX535 applications processor
i.MX Portfolio
View the full i.MX portfolio, compare features and performance. Detailed look at the i.MX51 family also available.
View the complete i.MX portfolio now
Featured Videos
Future of Smart Mobile Devices - Take 1
(Video - 2:02) The first in a series of future smart mobile devices concepts based on Freescale technology
Freescale eReader system solution
(Video - 5:22) Highlights of Freescale's industry-leading eReader solutions including the new SABRE reference design
Future of Smart Mobile Devices ?Take 3
(Video 2:11) The third in a series of future smart mobile devices concepts based on Freescale technology
Customer Notice
Because of an order from the United States International Trade Commission, BGA-packaged product lines and part numbers indicated here currently are not available from Freescale for import or sale in the United States prior to September 2010: i.MX37 Product Family, i.MXS Product Family.
Learn More
Microsoft Announces Windows Compact 7
Jumpstart your Windows Embedded CE design!
Featured Products
eReader Reference Design
Based on i.MX51. Get started today
i.MX508 Processor
ARM Cortex™-A8 with integrated E Ink display controller
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Smart Mobile Devices Blog
by Freescale's consumer experts
i.MX Community
Share ideas, design tips and meet other i.MX fans
Internet
100%

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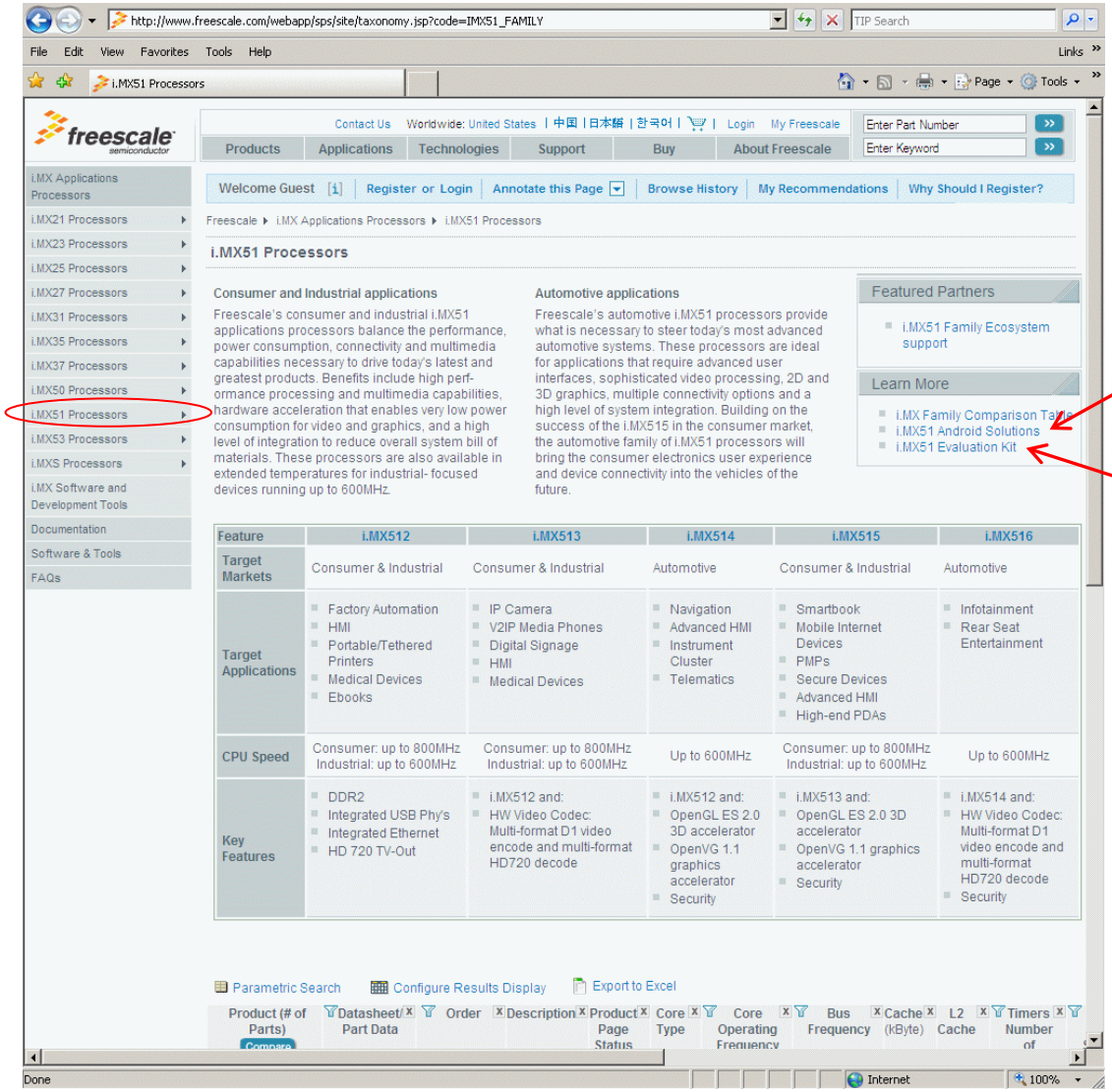
# i.MX51 Information

- http://www.freescale.com/webapp/sps/site/taxonomy.jsp?code=IMX51_FAMILY

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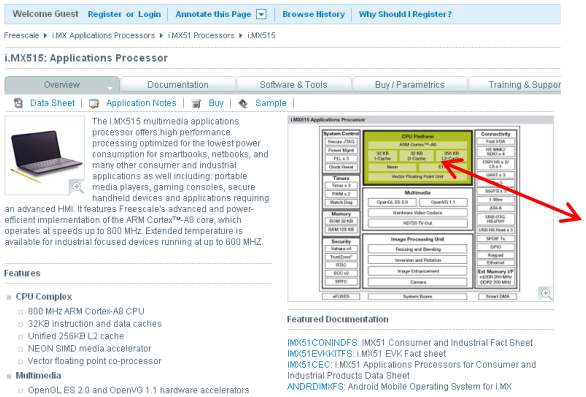
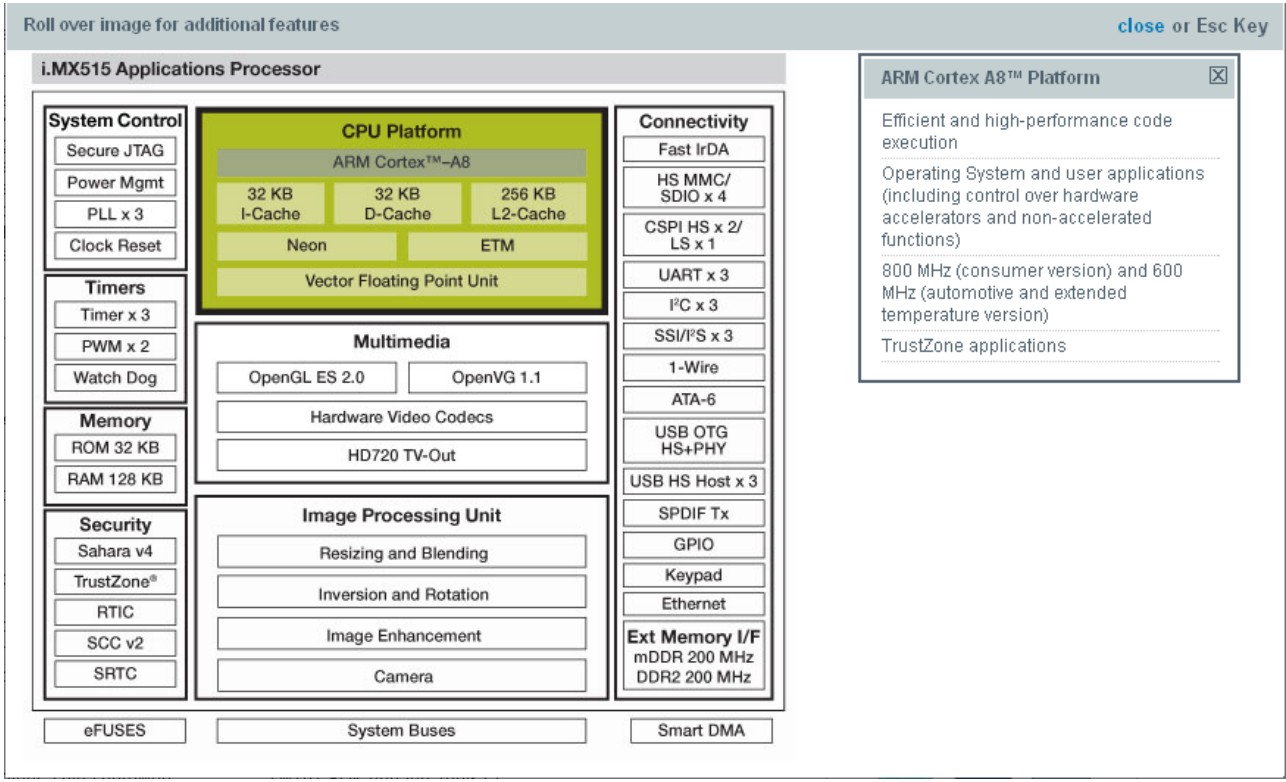
# Freescale Web Resource Enhancement

- For example, click to i.MX515 main page:
  http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=i.MX515


Welcome Guest Register or Login Annotate this Page Browse History Why Should I Register?
Freescale ▸ i.MX Applications Processors ▸ i.MX51 Processors ▸ i.MX515
i.MX515: Applications Processor
Overview Documentation Software & Tools Buy / Parametrics Training & Support
Data Sheet Application Notes Buy Sample
The i.MX515 multimedia applications processor offers high performance processing optimized for the lowest power consumption for smartbooks, netbooks, and many other consumer and industrial applications as well including: portable media players, gaming consoles, secure handheld devices and applications requiring an advanced HMI. It features Freescale's advanced and power-efficient implementation of the ARM Cortex™-A8 core, which operates at speeds up to 800 MHz. Extended temperature is available for industrial focused devices running at up to 600 MHZ.
Features
CPU Complex
800 MHz ARM Cortex-A8 CPU
32KB instruction and data caches
Unified 256KB L2 cache
NEON SIMD media accelerator
Vector floating point co-processor
Multimedia
OpenGL ES 2.0 and OpenVG 1.1 hardware accelerators
Featured Documentation
IMX51CONINDFS: IMX51 Consumer and Industrial Fact Sheet
IMX51EVKITFS: i.MX51 EVK Fact sheet
IMX51CEC: i.MX51 Applications Processors for Consumer and Industrial Products Data Sheet
ANDRDIMXFS: Android Mobile Operating System for i.MX

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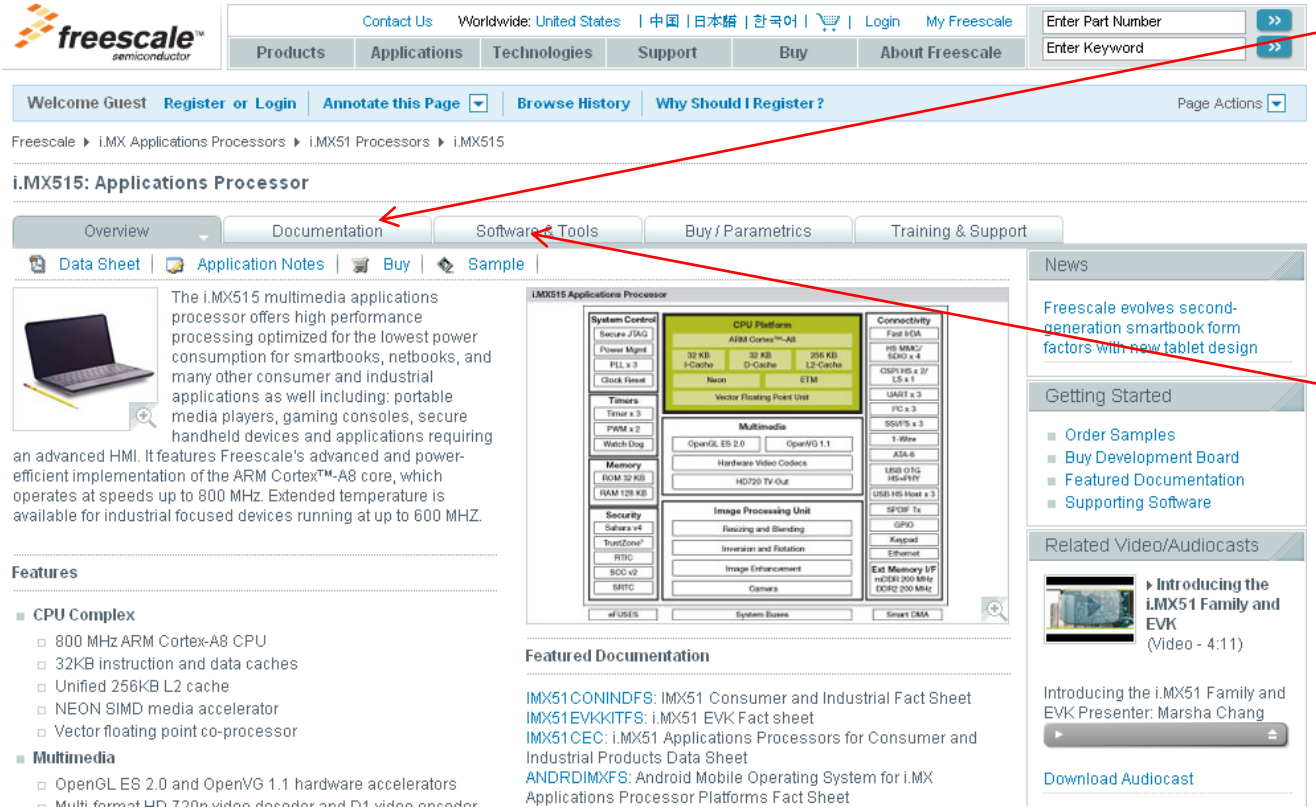
# i.MX515 IC Information

- http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=i.MX515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i.MX515: Applications Processor
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Data Sheet
Application Notes
Buy
Sample
The i.MX515 multimedia applications processor offers high performance processing optimized for the lowest power consumption for smartbooks, netbooks, and many other consumer and industrial applications as well including: portable media players, gaming consoles, secure handheld devices and applications requiring an advanced HMI. It features Freescale's advanced and power-efficient implementation of the ARM Cortex™-A8 core, which operates at speeds up to 800 MHz. Extended temperature is available for industrial focused devices running at up to 600 MHZ.
Features
CPU Complex
800 MHz ARM Cortex-A8 CPU
32KB instruction and data caches
Unified 256KB L2 cache
NEON SIMD media accelerator
Vector floating point co-processor
Multimedia
OpenGL ES 2.0 and OpenVG 1.1 hardware accelerators
Featured Documentation
IMX51CONINDFS: IMX51 Consumer and Industrial Fact Sheet
IMX51EVKKITFS: i.MX51 EVK Fact sheet
IMX51CEC: i.MX51 Applications Processors for Consumer and Industrial Products Data Sheet
ANDRDIMXFS: Android Mobile Operating System for i.MX Applications Processor Platforms Fact Sheet
News
Freescale evolves second-generation smartbook form factors with new tablet design
Getting Started
Order Samples
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Supporting Software
Related Video/Audiocasts
Introducing the i.MX51 Family and EVK
(Video - 4:11)
Introducing the i.MX51 Family and EVK Presenter: Marsha Chang
Download Audiocast

## Documentation TAG

- IC Data Sheet, User Manual etc
- Application Notes
- BSP User Manual

## Software Tools TAG

- FSL Tools
- FSL BSP
- IC IBIS Models etc
- Freescale 3rd Party Tools Info

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# i.MX51 EVK [*aka* BBG 3.0]

- http://www.freescale.com/imx51evk

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Freescale ▸ i.MX Applications Processors ▸ i.MX51 Processors ▸ MCIMX51EVKJ
i.MX51 Evaluation Kit
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Application Notes
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Freescale delivers the cost-effective i.MX51 evaluation kit, allowing customers to develop, debug and demonstrate their next great product without compromising performance. As part of our new price, performance and personality series, the evaluation kit supports all the features of the device in design to enable developers a complete development platform at a low price point estimated at $700USD . The i.MX51 EVK has two optional add-on modules; an LCD and an expansion board. Based on a powerful ARM Cortex-A8 core, the i.MX51 EVK delivers extreme performance and provides long battery life helping developers design products that meet today's demands for energy efficiency. A range of connectivity options makes the i.MX51 EVK suitable for developing many different types of user applications.
The provided Board Support Packages (BSP) for Linux® and Windows® Embedded CE enables rapid prototyping to help speed up the processor selection process and quickly deliver a demo into the hands of the project stakeholders. The i.MX51 EVK includes two SD cards; one pre-loaded with Linux and the other with Windows Embedded CE. Both options support a wide range of automotive, consumer, general embedded and industrial applications.
Features
CPU
i.MX51 Evaluation Kit Assembled with LCD and Expansion Boards
Supported Device Families
i.MX51 Family
See All
Featured Documentation
News
Freescale extends product family that pioneered the smartbook category to address additional embedded markets
What Freescale's ecosystem partners have to say about the i.MX51family
Robust software offering for the i.MX51 family of processors
Featured Video
Introducing the i.MX51 Family and EVK
(Video - 4:11)
Audiocast
Introducing the i.MX51 Family and EVK Presenter: Marsha Chang

## Documentation TAG

- Application Notes
- BSP User Manual

## Software Tools TAG

- WinCE & Linux BSP
- EVK Schematics

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# i.MX51 EVK [*aka* BBG 3.0] (cont)

- The evaluation kit for development

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Freescale ▸ i.MX Applications Processors ▸ i.MX51 Processors ▸ MCIMX51EVKJ

**i.MX51 Evaluation Kit**

Overview | Documentation | Downloads | Buy / Specifications | Training & Support

Orderable Parts Information

| Order Availability | Part Number | Description | Tool Type | Status | Budgetary Price($US) | Compliance: Package Peak | Compliance | Replacement Part |
|---|---|---|---|---|---|---|---|---|
| Buy Direct / Distributor | MCIMX51EVKJ | MCIMX51EVKJ | Hardware | Active | 1 @ $699.00 each | | | |
| Buy Direct / Distributor | MCIMX51EXP | Hardware / Software / Tech Support Bundle I.MX51 EXPANSION CARD | Hardware | Active | 1 @ $200.00 each | | | |
| Buy Direct / Distributor | MCIMX51LCD | Hardware Only I.MX51 WVGA LCD DAUGHTER | Hardware | Active | 1 @ $250.00 each | | | |

NOTE:
- Not all orderable parts are offered through our online sampling program. For further assistance in selecting a similar part from within the a sample order advice.
- Refer to FAQ for more information.
- Looking for an obsolete part? Check our new part number search

▲ Return to Top

Because of an order from the United States International Trade Commission, BGA-packaged product lines and part numbers indicated here currently are not available from Freescale for import or sale in the United States prior to September 2010 : Indicated by the Icon ( )

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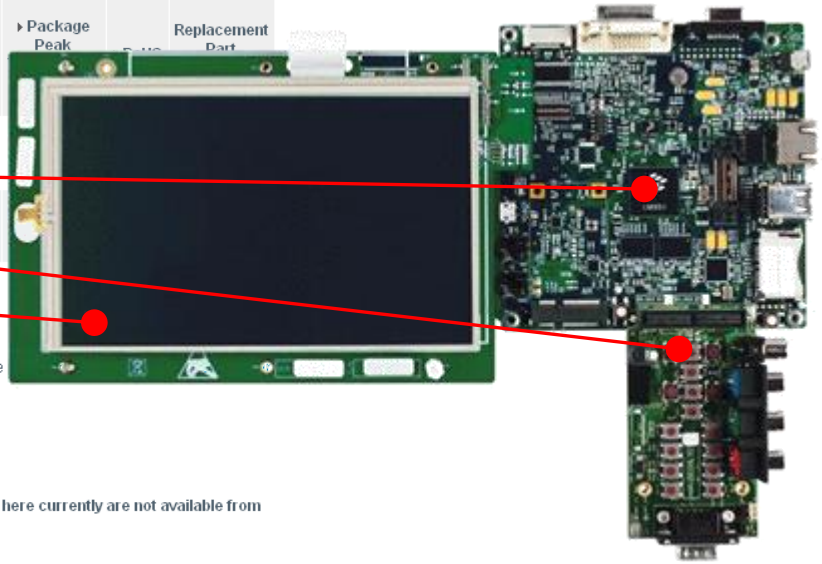

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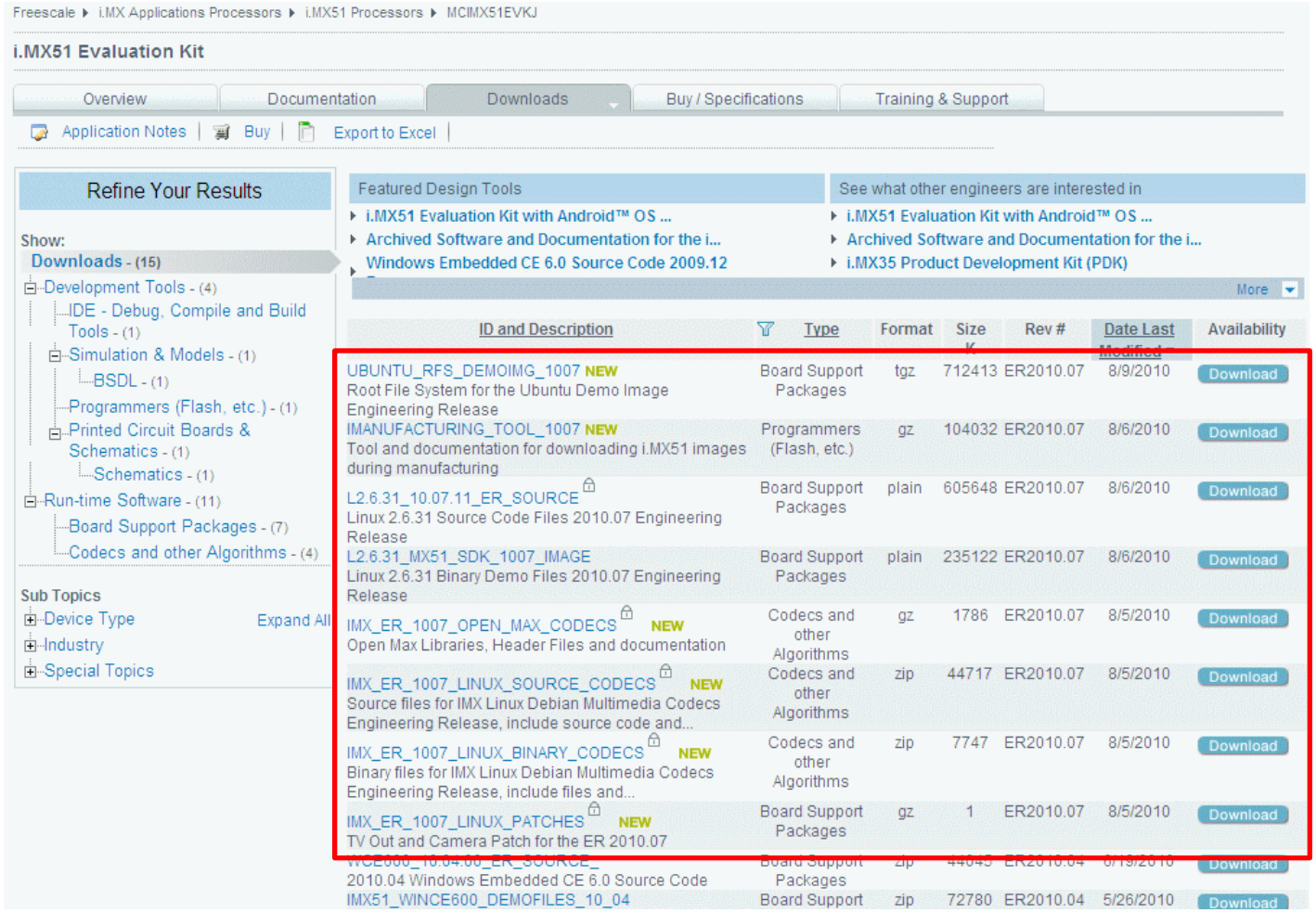
# Linux BSP(1007) on Freescale website

- http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MCIMX51EVKJ&nodeId=0162468rH31143ZrDR633B&fpsp=1&tab=Design_Tools_Tab




- Ubuntu 9.10 Karmic Rootfs
- BSP Source Code
- Prebuilt image
- MM Codec Package: OpenMAX
- MM Codec Package: Gstreamer (LTIB)
- MM Codec Package: Gstreamer (Ubuntu)
- Kernel Patch fro TVout

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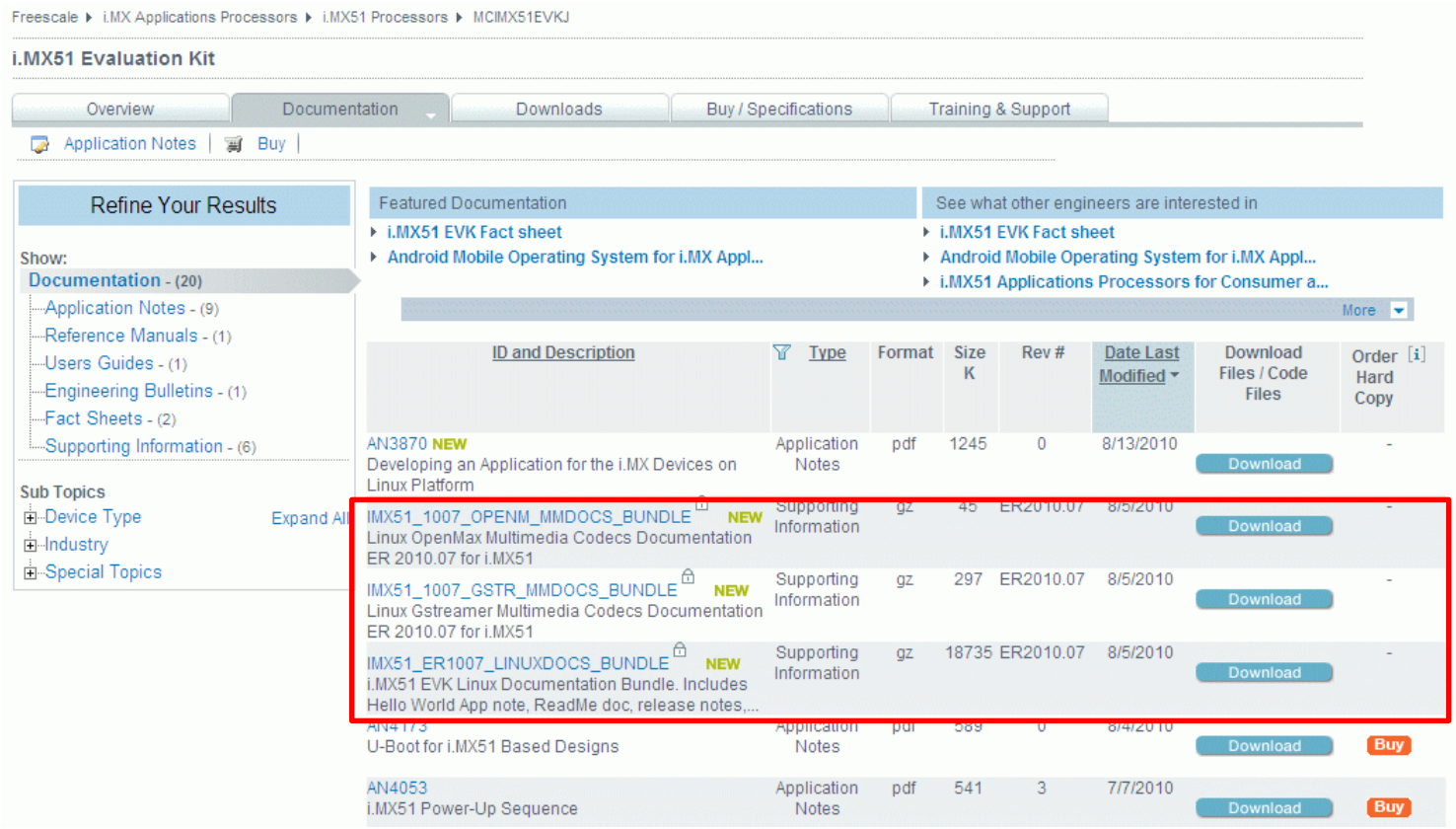
# Linux BSP document on Freescale website

- http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MCIMX51EVKJ&nodeId=0162468rH31143ZrDR633B&fpsp=1&tab=Documentation_Tab




- Doc for MM Codec Package: OpenMAX
- Doc for MM Codec Package: Gstreamer
- Doc for BSP

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# Linux BSP release packages

Source package (L2.6.31_10.07.11_ER_source_bundle.tar.gz)

- LTIB
- Boot loader sources (redboot & uboot) and toolchain
- Kernel and driver sources (kernel.org code + FSL patches)
- User space packages
- Compiler/Linker and friends (GNU ARM, currently 4.1.2 eABI/VFP)

Documentation (L2.6.31_10.07.11_ER_docs.tar.gz)

- BSP release note, user guide and reference manual
- Resolved and Unresolved Defects status
- Feature matrix for each supported chip/HW

Binary Image package (L2.6.31_10.07.11_ER_images_MX5X.tar.gz)

- Kernel binary for each supported chip/HW
- Root file system image for each supported chip/HW
- Boot loader binary image for each supported chip/HW

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# BSP Naming Nomenclature

- Filename on Web site uses the SDK YY.MM concept – example SDK 10.07
- Note: Date does not necessarily reflect the LATEST date, just the software development cycle date BEFORE testing.

- BSP Package:
  - OSVersion_shortCMid_ ReleaseType_ Releasedate
  - OS version: e.g. L2.6.31
  - ShortCMid: The CM version of BSP, xx.yy.zz=Year.Month.zz, to differentiate the release month from the version number.
  - ReleaseType: ER – Engineering Release
  - SS – Snapshot Release
  - SDK – SDK Release
  - L2.6.31_10.07.ER_SDK

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# Moral of the Story?

- Good information can be found on Freescale's Web site … if you know where to look.
- Find important documents in the MCIMXEVK's *Documentation* and *Downloads* tabs.
- Also look under the specific iMX51's *Documentation* and *Downloads* tabs.
- The website : http://www.freescale.com/imxtools is alive and it could simplify the information search

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# http://www.freescale.com/imxtools Alive

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File Edit View Favorites Tools Help
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Contact Us Worldwide: United States 中国 日本語 한국어 Login My Freescale
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Enter Part Number
Enter Keyword
Welcome Guest Register or Login Annotate this Page Browse History My Recommendations Why Should I Register? Page Actions
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i.MX Software and Development Tools
Take your designs to the next level, reduce you design complexity and accelerate your time to market with i.MX software and development solutions. The tools supplied on these pages will provide you with exactly what you need to build comprehensive solutions.
Reduced costs are also important when building your solutions. That's why at no cost, customers can download binary and source device drivers, as well as a full suite of multimedia codecs.
Embedded Software and Development Tools
i.MX Embedded Software by Device
i.MX23 Processor Software
i.MX25 Processors
i.MX35 Processors
i.MX51 Processors
i.MX Embedded Software by Operating Systems
Android
Linux
Windows Embedded
i.MX Development Boards and Systems by Device
i.MX23
i.MX25
i.MX27
i.MX31
i.MX35
i.MX51
Design Resources
Getting Started
All Freescale Alliance Members
▸ Introducing the i.MX535 for Tablets and Smart Mobile Devices
Optimized for a wide range of operating systems, plus HD 1080p video playback and hardware-accelerated Adobe® Flash® 10.1, the i.MX535 offers a full hardware and software solution to design next-generation consumer devices.
Meet the new i.MX535 applications processor
i.MX Embedded Software Features Portfolio
i.MX Portfolio
An at-a-glance resource for operating system features by i.MX family.
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Featured Videos
▸ Visteon Connected Car i.MX51 Infotainment Solution Demo
(Video - 2:07) What an advanced audio infotainment system should do once connected to the internet, including content management.
▸ i.MX51 Multimedia and Graphics Powerhouse
(Video - 2:51) Featuring simultaneous OpenGL ES 2.0 graphics and high performance video, an integrated and validated Board Support Package for Linux operating systems, and the ARM Cortex™ -A8 technology.
▸ i.MX51 User Interface Demo
(Video - 1:51) Demonstrating Ubuntu on the i.MX51 applications processor showing the user interface and video playback.
Our Software Solutions
Customer Application
Config / Dev Tools
Stacks Applications
Drivers APIs Libraries
OS BSP HAL Hypervisor
Processor
Featured Reference Design
▸ eReader Reference Design
Based on i.MX51. Get started today
Connect With Us
▸ Smart Mobile Devices Blog
by Freescale's consumer experts
▸ i.MX Community
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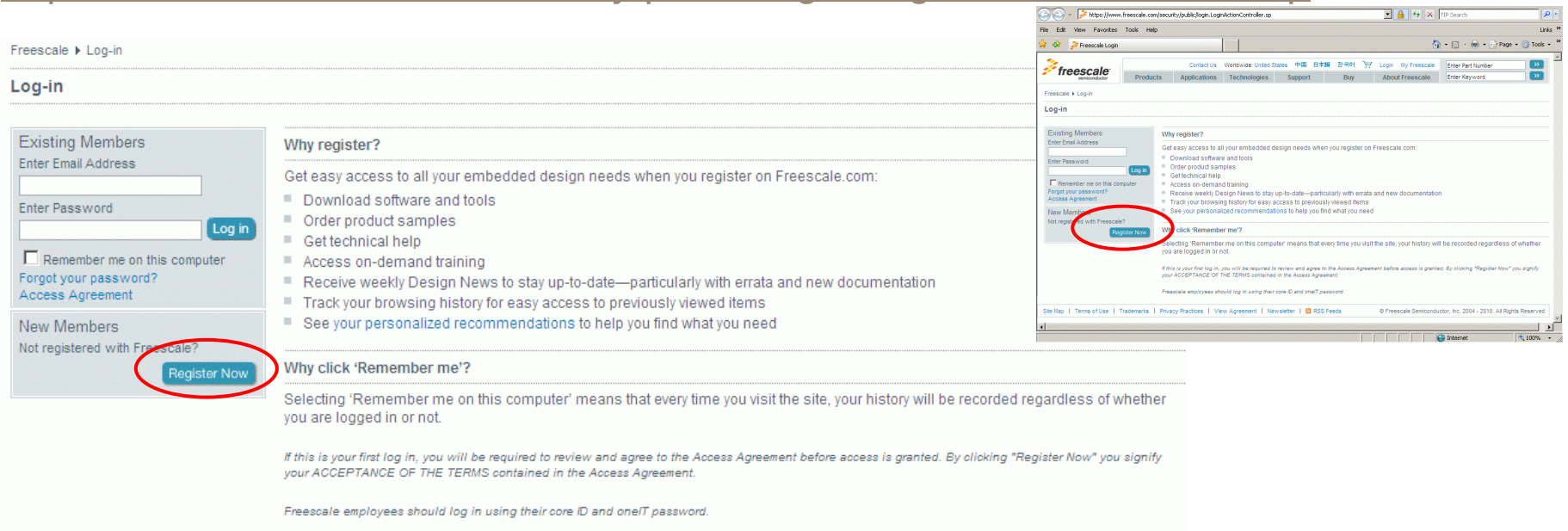
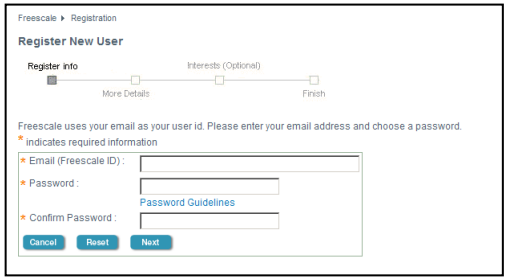
# Freescale Member Registration for web resource download

1. For first time user, register to Freescale WEB site using this link and press “Register Now”

   https://www.freescale.com/security/public/login.LoginActionController.sp


Freescale ▸ Log-in
Log-in
Existing Members
Enter Email Address
Enter Password
Log in
Remember me on this computer
Forgot your password?
Access Agreement
New Members
Not registered with Freescale?
Register Now
Why register?
Get easy access to all your embedded design needs when you register on Freescale.com:
Download software and tools
Order product samples
Get technical help
Access on-demand training
Receive weekly Design News to stay up-to-date—particularly with errata and new documentation
Track your browsing history for easy access to previously viewed items
See your personalized recommendations to help you find what you need
Why click ‘Remember me’?
Selecting ‘Remember me on this computer’ means that every time you visit the site, your history will be recorded regardless of whether you are logged in or not.
If this is your first log in, you will be required to review and agree to the Access Agreement before access is granted. By clicking "Register Now" you signify your ACCEPTANCE OF THE TERMS contained in the Access Agreement.
Freescale employees should log in using their core ID and oneIT password.

2. Input your email address and choose your login password and then press “Next” to continue:

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# www.iMXcommunity.org

**A Freescale supported open web community of developers sharing common interest in transforming i.MX applications processors into practically anything imaginable.**

## i.MX Community

- Serves all component enablement peripherals including basic to complex software
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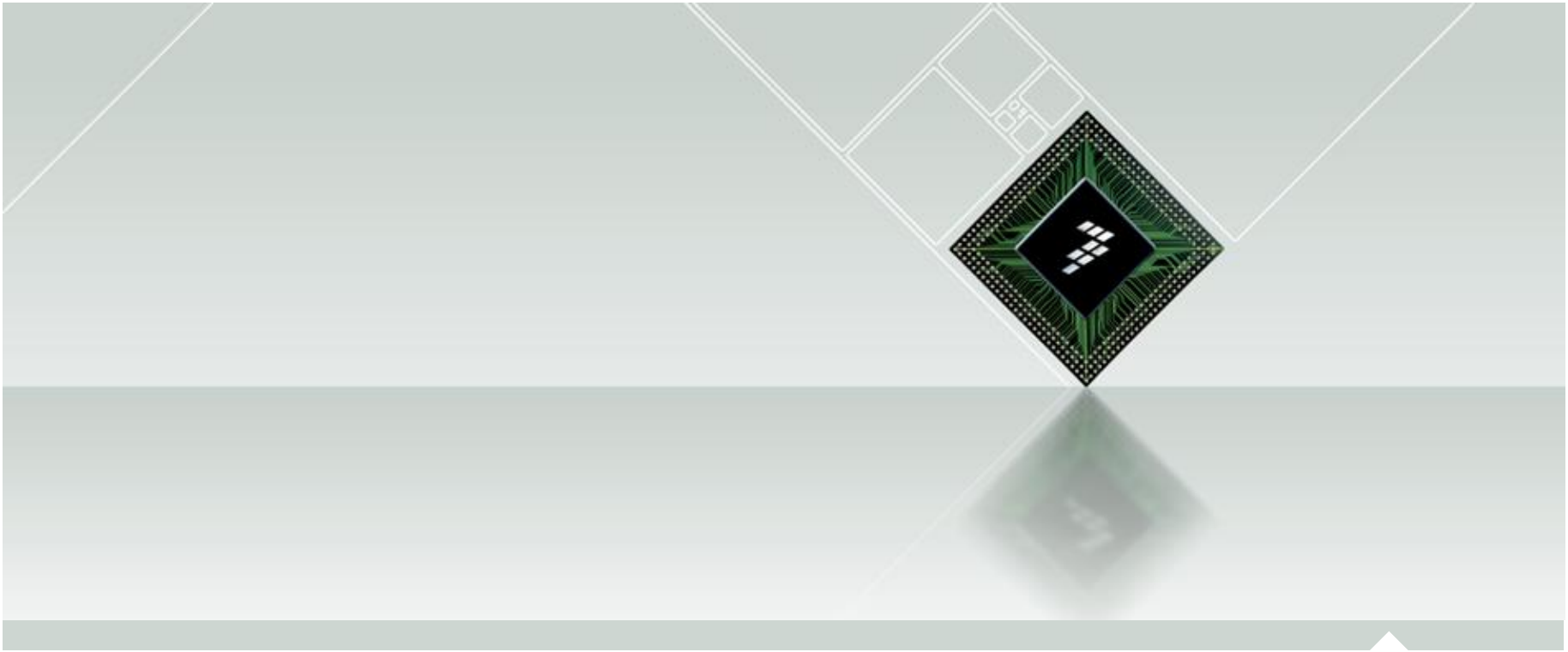

# Freescale Tools

## ATK – Advanced Tool Kit & Manufacturing Tool

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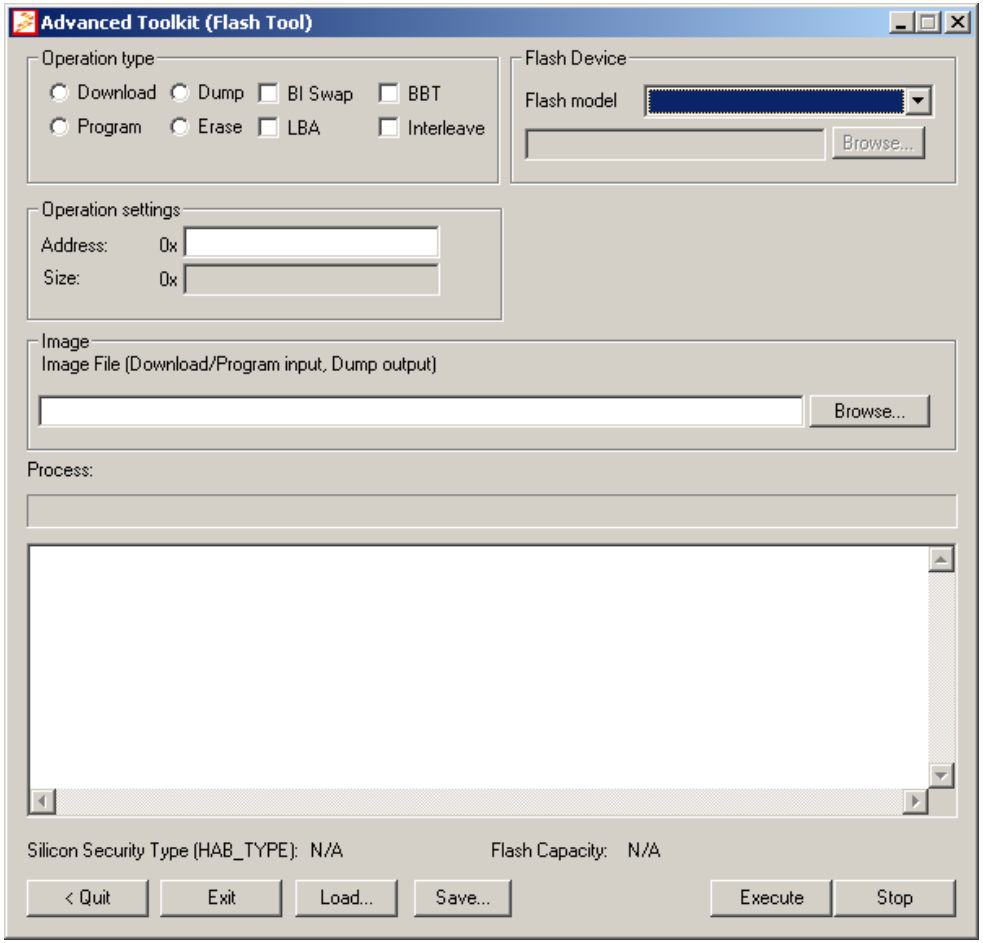
# ATK Details

- ATK – Advanced Tool Kit
  - Mainly used to program flash
  - *Hybrid* Windows/Arm application
  - Full source is given for both Windows and ARM code




- Not a substitute for JTAG tool … but:
  - Can assist with board bring-up
  - Can be used with Diagnostics
  - Can setup and program:
    - Nand
    - Nor
    - SD
    - SDRAM

- Flash can be totally blank!
  (No bootcode needed)

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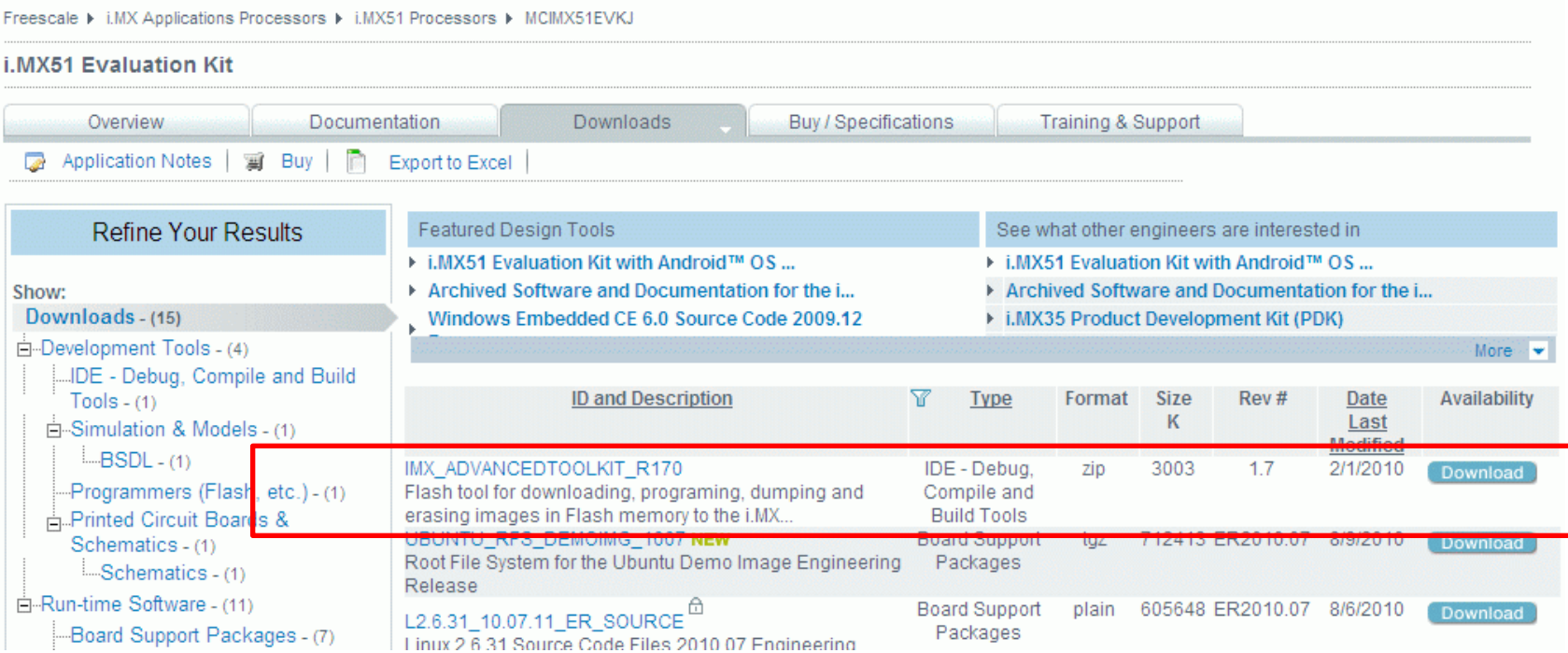
# ATK R1.70 on Freescale website

- http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MCIMX51EVKJ&nodeId=0162468rH31143ZrDR633B&fpsp=1&tab=Design_Tools_Tab

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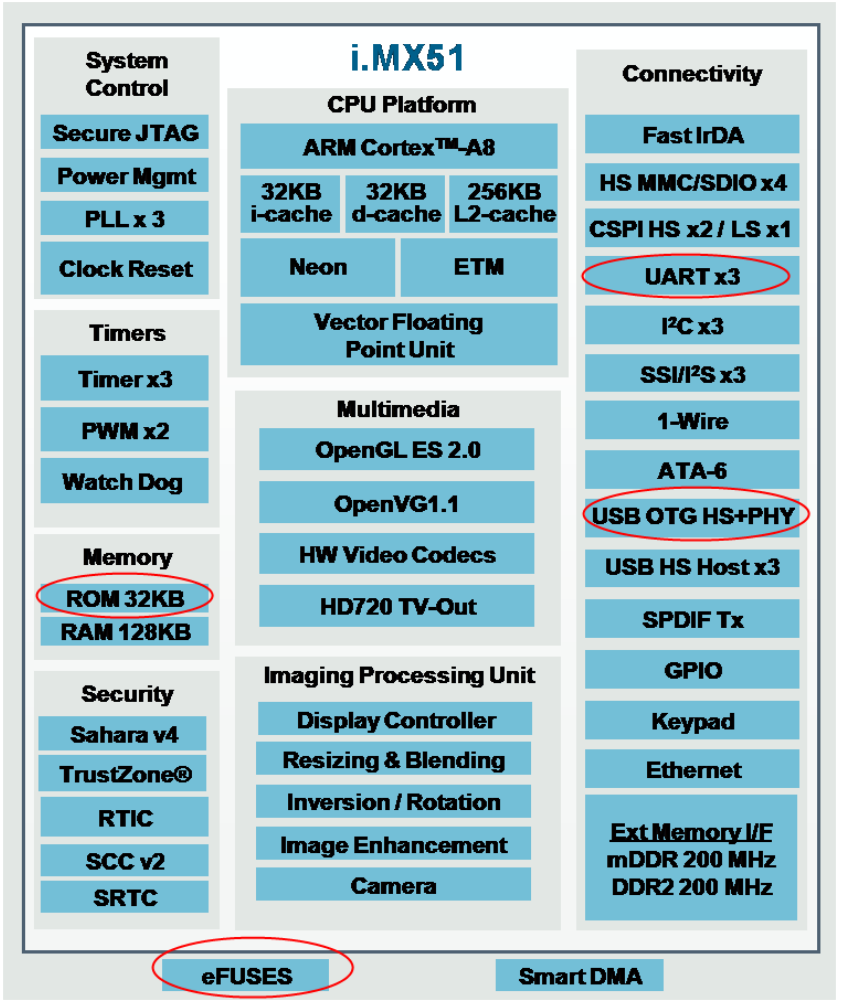
# How ATK Works

- On Board Rom and E-Fuses are used to *Bootstrap* processor
- Uart or USB is used to transfer data between Host and Target
- On the EVK, *USB/UART* bootstrap mode is accomplished by changing some dip switches

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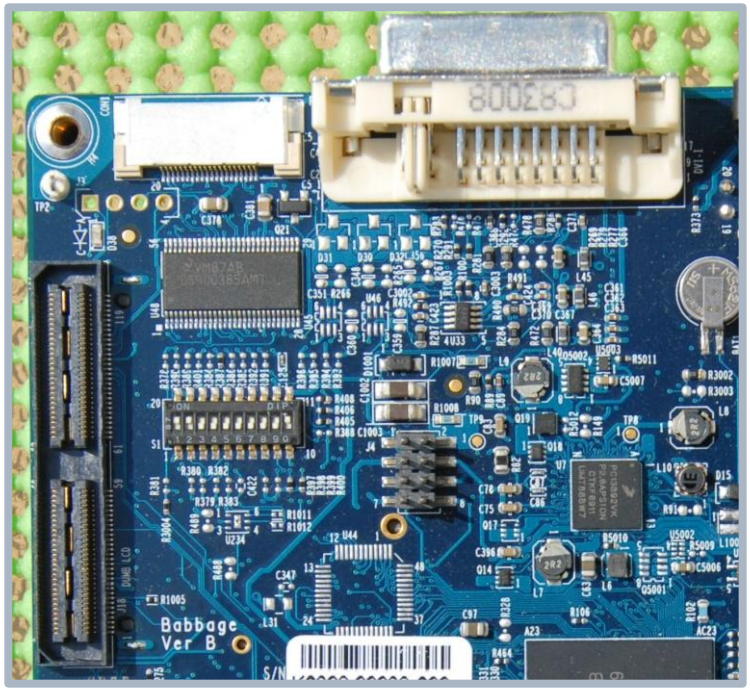
# Dip Switches

- Dip Switches can substitute for EFUSES but are a SUBSET of all options
- BOOT_MODE Internal or External boot.
  - Today, use *Internal* boot in all cases
- BUS_WIDTH For Nor/Nand, size of data bus. For SPI, size of Address Word (16- or 24-bit)
- MEM_CTL selects NOR, NAND or Expansion
- *MEM_TYPE* used in conjunction with *MEM_CTL* to set options such as address cycles for NAND
- *BT_SRC* Selects SD1 or SD2
  - SD2 is not powered upon boot by default, booting from TOP card requires MODS
- LID (GPIO for Lid of Laptop Emulation)
- PWR: Very Important
  - Used to override the *Soft Power* switch
    Useful recommendation – leave this *ON*

| | S1 S2 | S3 | S4 S5 | S6 | S7 S8 | S9 | S10 |
|---|---|---|---|---|---|---|---|
| | BOOT_MODE | BUS_WIDTH | MEM_TYPE | BT_SRC | MEM_CTL | LID | PWR |
| **SPI Flash** | 0 0 | 1 | 1 1 | 0 | 1 1 | X | 1* |
| **SD/MMC** | 0 0 | 0 | 0 0 | 0 | 1 1 | X | 1* |
| **Uart/USB Bootstrap** | 1 1 | X | X X | X | X X | X | 1* |

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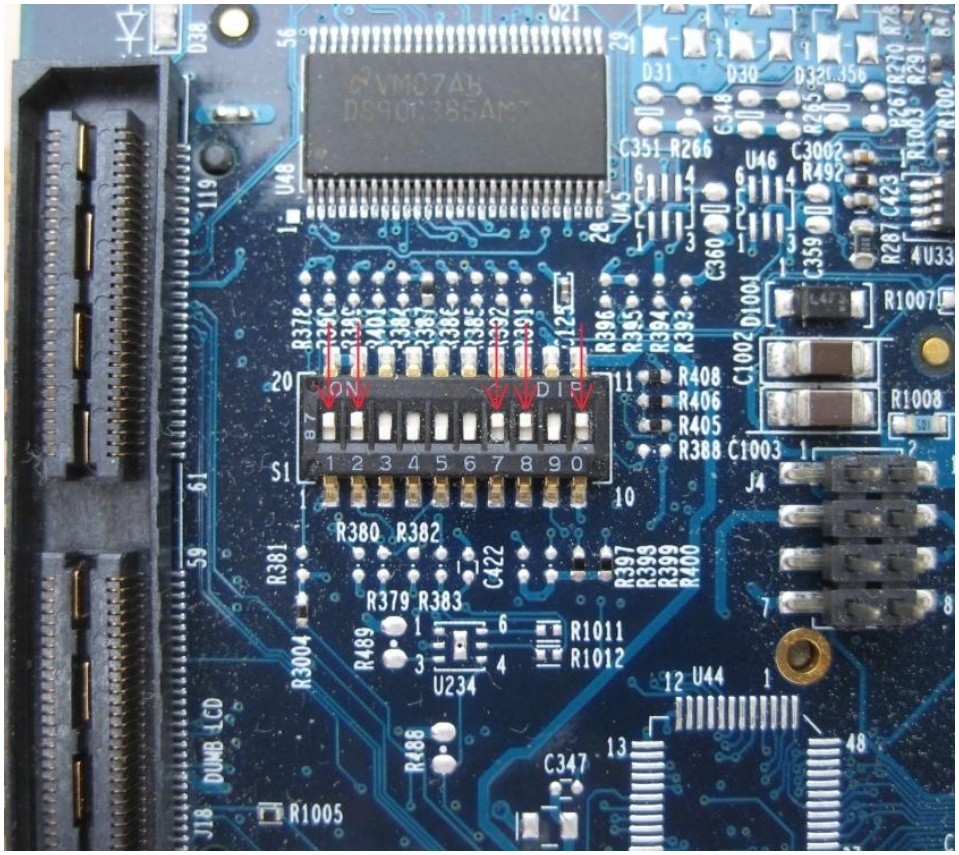
# Dip Switches

- We are going to need to set the boot switches for next step.

- Please set to following:
  - 1 and 2 ON (UP)
  - 3, 4,5 and 6 OFF (Down)
  - 7 and 8 ON (UP)
  - 9 OFF (Down)
  - 10 ON (UP) *

| | S1 S2 | | S3 | S4 S5 | | S6 | S7 S8 | | S9 | S10 |
|---|---|---|---|---|---|---|---|---|---|---|
| | BOOT_ MODE | | BUS_ WIDTH | MEM_ TYPE | | BT_ SRC | MEM_ CTL | | LID | PWR |
| **SPI Flash** | 0 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | X | 1* |
| **SD/MMC** | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | X | 1* |
| **Uart/USB Bootstrap** | 1 | 1 | X | X | X | X | X | X | X | 1* |

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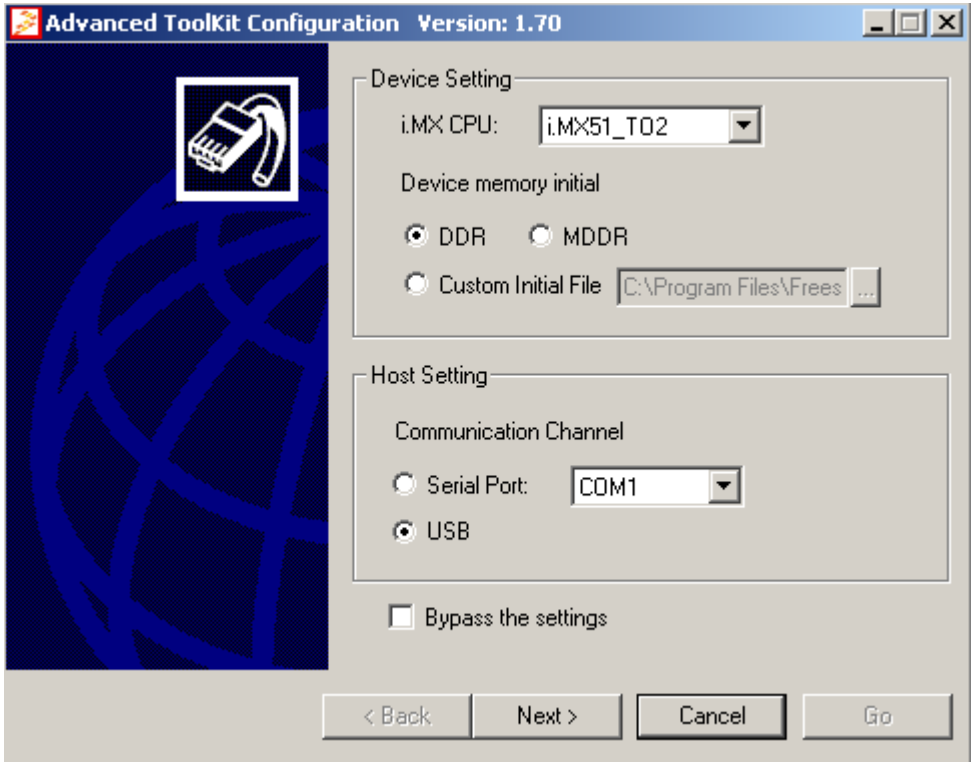
# Time to Try ATK

- Program a bootloader to SD card …
- Start ATK from *Desktop* and configure as shown.
- Discussion: *Custom Initial File* points to TXT file which performs initialization of Memory
- C:\Program Files\Freescale\AdvancedToolKit-STD\example\memory_init
- EXAMPLE: Format is

| Address in Hex | Value | Byte Width |
|---|---|---|
| 0xB8001000 | 0x82220080 | 32 |
| 0x82000400 | 0xDA | 8 |

- Selecting the *Default* of *DDR* is for EVK

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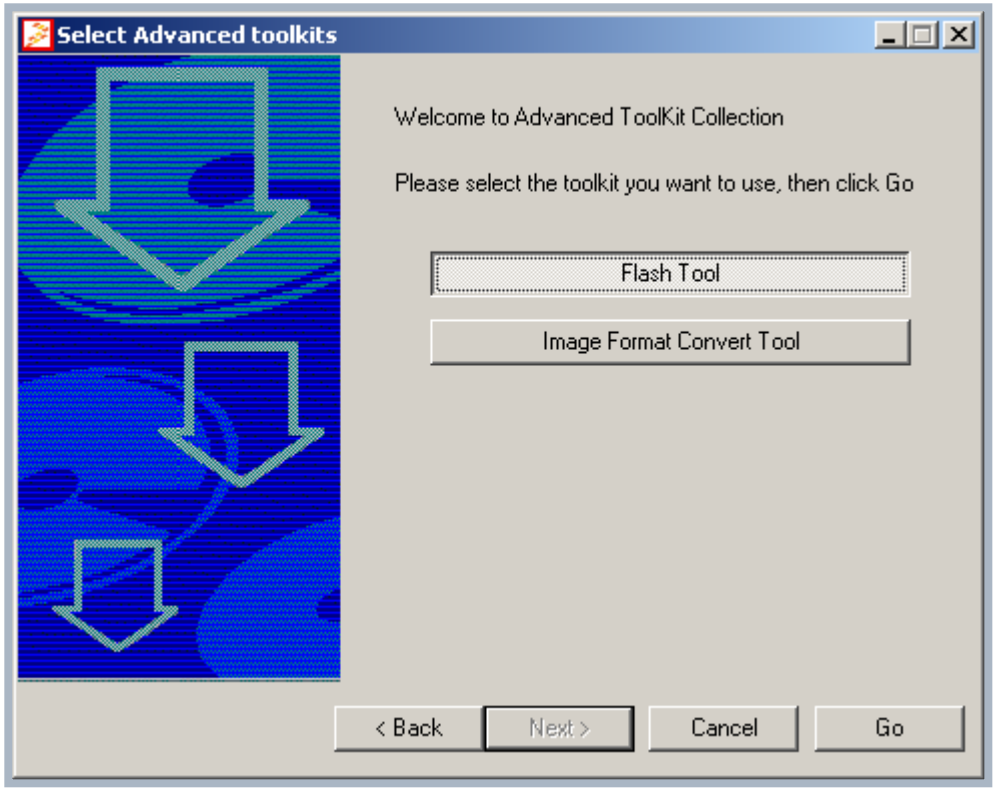
# ATK Continued

- Select *Flash Tool*, and then *Go*
- Image Format option will convert from <-> to different standard file formats

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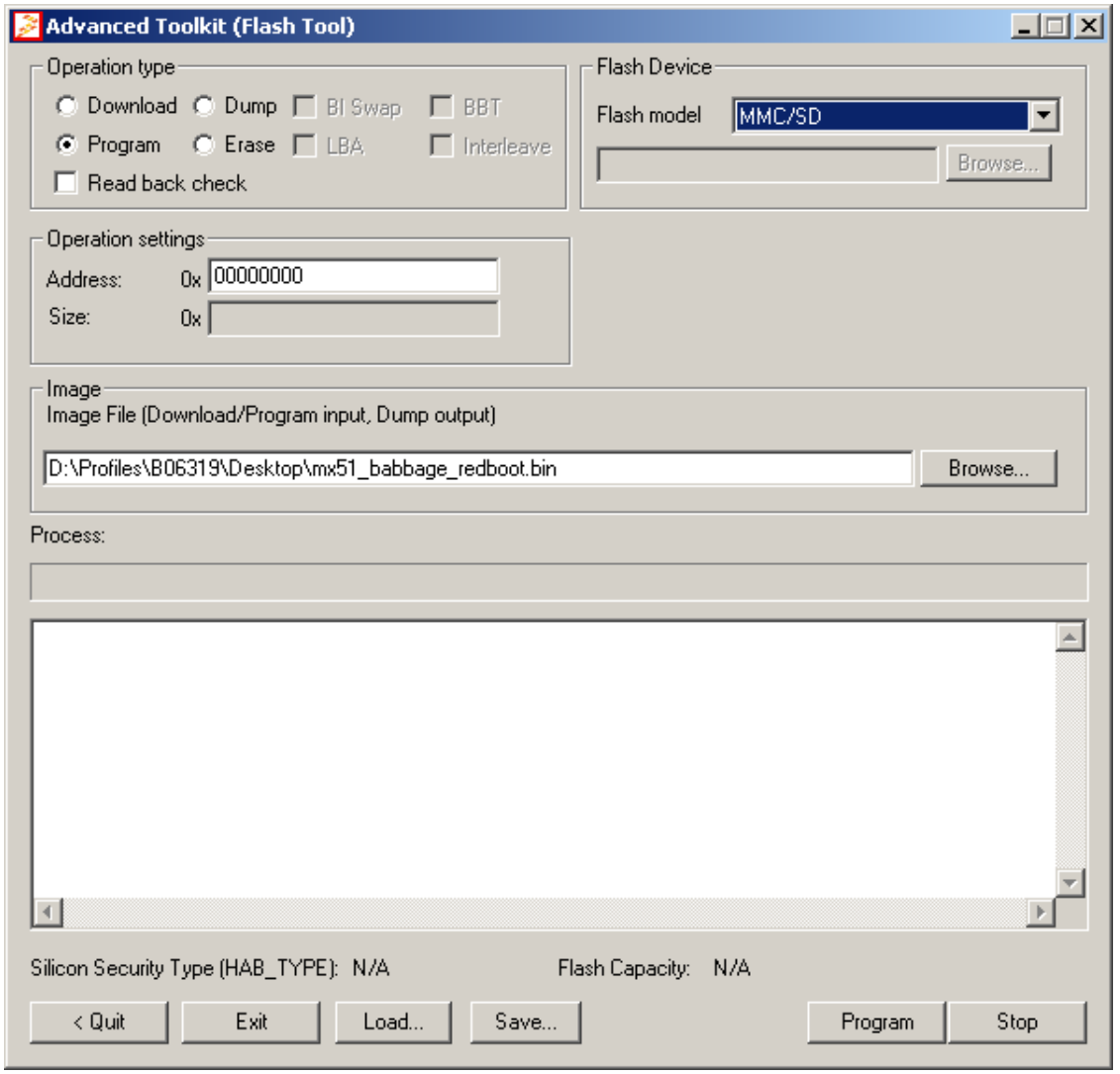
# ATK Continued

- Setup ATK as shown
- With power *Off*, we **MUST** put board in *UART/USB BOOTSTRAP* mode. Switches 1 and 2 *ON (we did this in prior slides)*
- Turn on board and click *Program*

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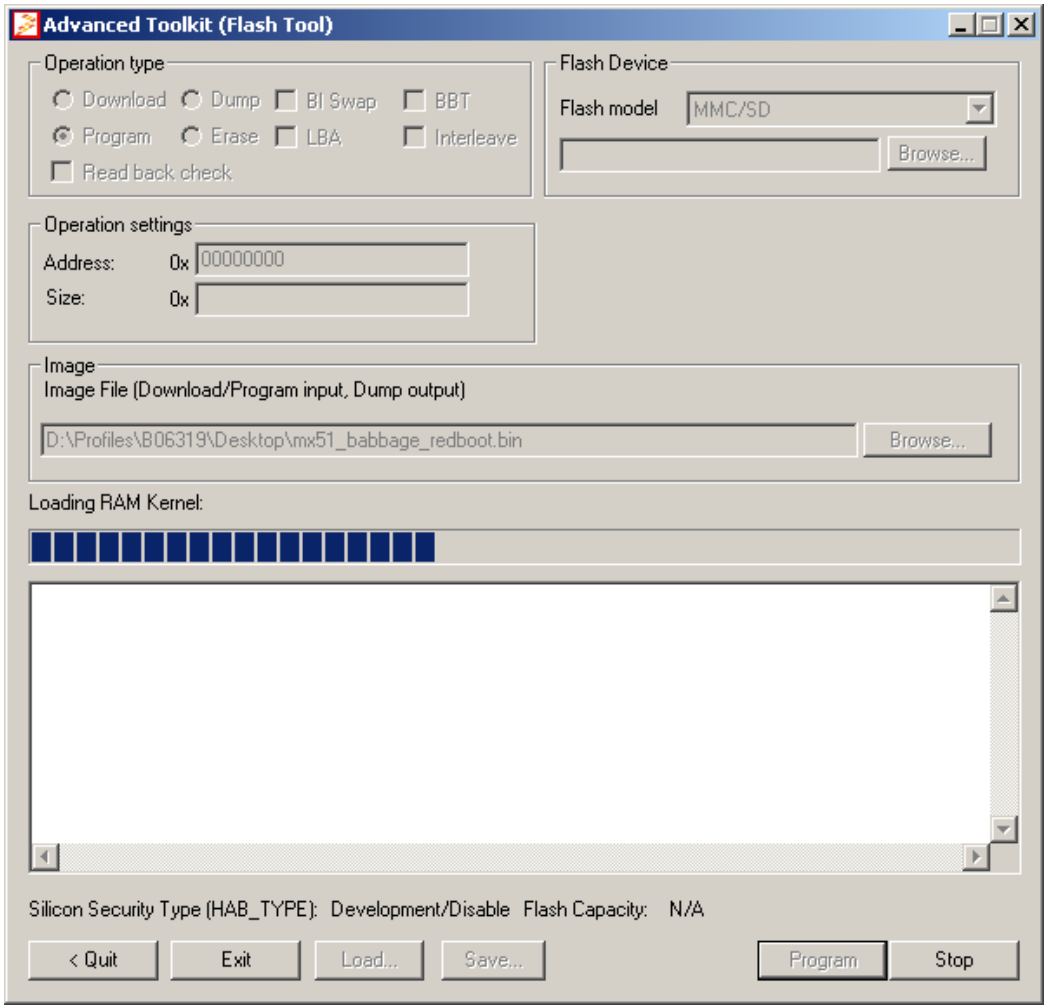
# ATK … Useful Hints

- Click *Program* and the term *Development/Disable* appears at the base
- This is the ROM Kernel successfully interacting with target.
- It downloads the RAM Kernel which does the *Dirty Work* (Flash programming)
- Hint: During board bring-up, test if the board is *alive* without writing one line of code!

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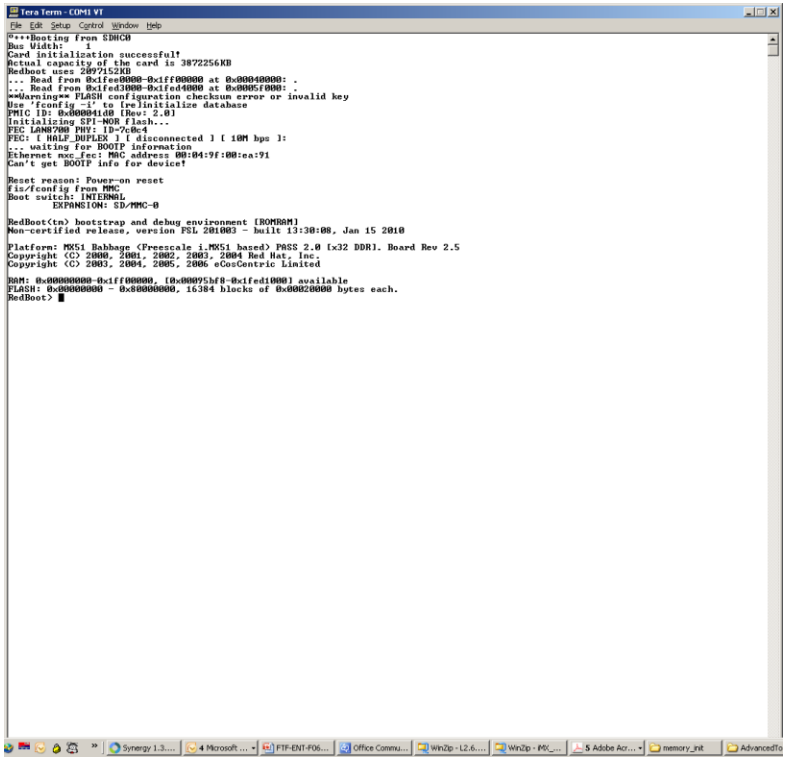
# Testing Programmed Bootloader

- Put Dip switches 1 and 2 back to *Off* for *Internal* boot (used in this case to boot from SD)
- Make sure to ***close down*** **ATK**
- Fire up *Tera Term* from shortcut on *Desktop*
- Turn on *Power.*
- Do you see *REDBOOT*? Great!


Tera Term - COM1 VT
File Edit Setup Control Window Help
"***Booting from SDHC0
Bus Width: 1
Card initialization successful!
Actual capacity of the card is 3872256KB
Redboot uses 2097152KB
... Read from 0x1fee0000-0x1ff00000 at 0x00040000: .
... Read from 0x1fed3000-0x1fed4000 at 0x0005f000: .
**Warning** FLASH configuration checksum error or invalid key
Use 'fconfig -i' to (re)initialize database
PMIC ID: 0x00004140 (Rev: 2.0)
Initializing SPI-NOR flash...
FEC LAN8700 PHY: ID-7c0c4
FEC: [ HALF_DUPLEX ] [ disconnected ] [ 10M bps ]:
... waiting for BOOTP information
Ethernet mxc_fec: MAC address 00:04:9f:00:ea:91
Can't get BOOTP info for device!
Reset reason: Power-on reset
fis/fconfig from MMC
Boot switch: INTERNAL
EXPANSION: SD/MMC-0
RedBoot(tm) bootstrap and debug environment [ROMRAM]
Non-certified release, version PSL 201003 - built 13:30:08, Jan 15 2010
Platform: MX51 Babbage (Freescale i.MX51 based) PASS 2.0 (x32 DDR). Board Rev 2.5
Copyright (C) 2000, 2001, 2002, 2003, 2004 Red Hat, Inc.
Copyright (C) 2003, 2004, 2005, 2006 eCosCentric Limited
RAM: 0x00000000-0x1ff00000, [0x00075bf8-0x1fed1000] available
FLASH: 0x80000000 - 0x88000000, 16384 blocks of 0x00020000 bytes each.
RedBoot>

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# With ATK … the Sky is the Limit

- Full Source Code is available for ATK
  - For the GUI (Microsoft Visual Studio Based)
  - For the RAM KERNEL (Compiled with GNU/Cygwin)

- Can customize and add new:
  - Nor Flash Devices
  - Nand devices
  - SPI Devices

- Can turn ATK into a Manufacturing/Diag/Test Tool

- Also can load code DIRECTLY to SDRAM

- Search *AN3985* on Freescale's Web site for more info:

  *Customizing the Freescale Advanced Toolkit for i.MX Based Platforms*

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# Manufacturing Tool Fact Sheet

- What is the Manufacturing Tool (MfgTool)
  - Prepare multiple devices in parallel.
- Supported Devices – i.MX23, i.MX25, i.MX35, i.MX51….
- Supported OSes
  - Host – Windows XP, Windows 7
  - Firmware - Linux, WinCE

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# Manufacturing Tool: Basic Functions – Host Component

- The Mfg Tool host component is an operator friendly GUI interface for the firmware imaging process.
- The GUI associates a physical USB port to the firmware imaging operations and provides feedback to the operator.
- The Mfg Tool Framework is an architecture that supports:
  - Communication with various USB device drivers.
  - Loading firmware to ROM device enabling extended ROM functionality or complete application functionality.
  - Invoking commands supported by currently executing firmware.

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# Manufacturing Tool: Basic Functions – Firmware Component

- The Mfg Tool firmware component enables these basic functions:
  - Erasing the media.
  - Allocating the media.
  - Writing firmware to the media allocation(s).
- Additional functionality is important for consumer devices:
  - Initializing the file system on the media.
  - Preloading content in data area of media

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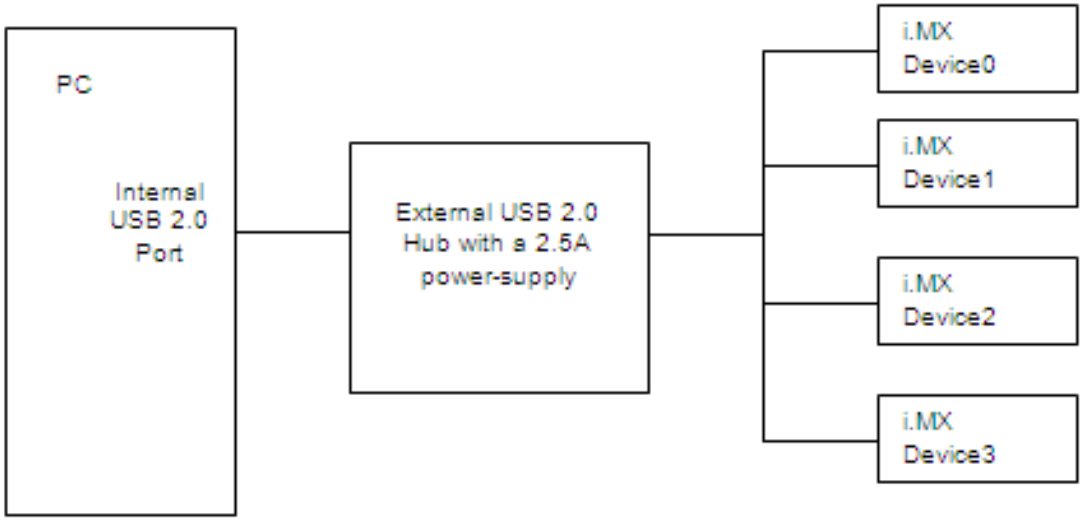
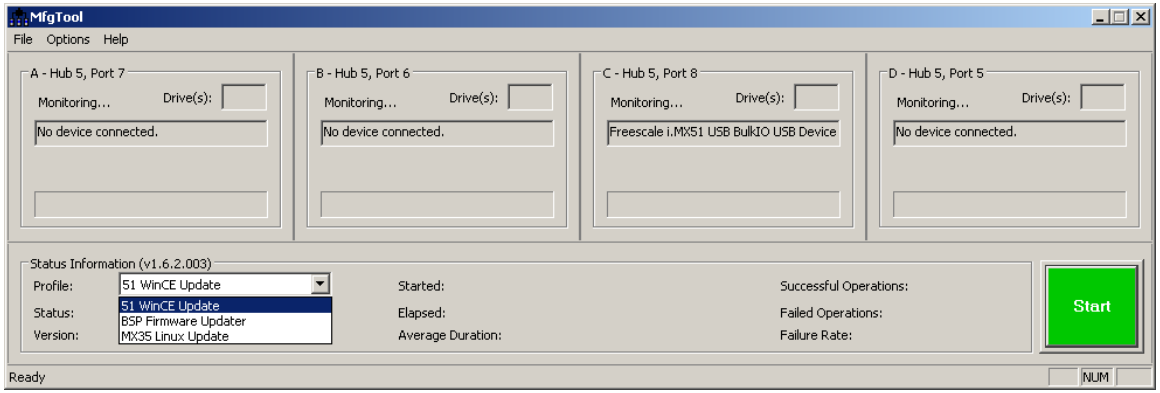
# Manufacturing Tool: Physical Setup and GUI

## Physical Setup

Connect the devices according to one of the diagrams below. Figure 1 represents the USB hub based physical setup configuration.

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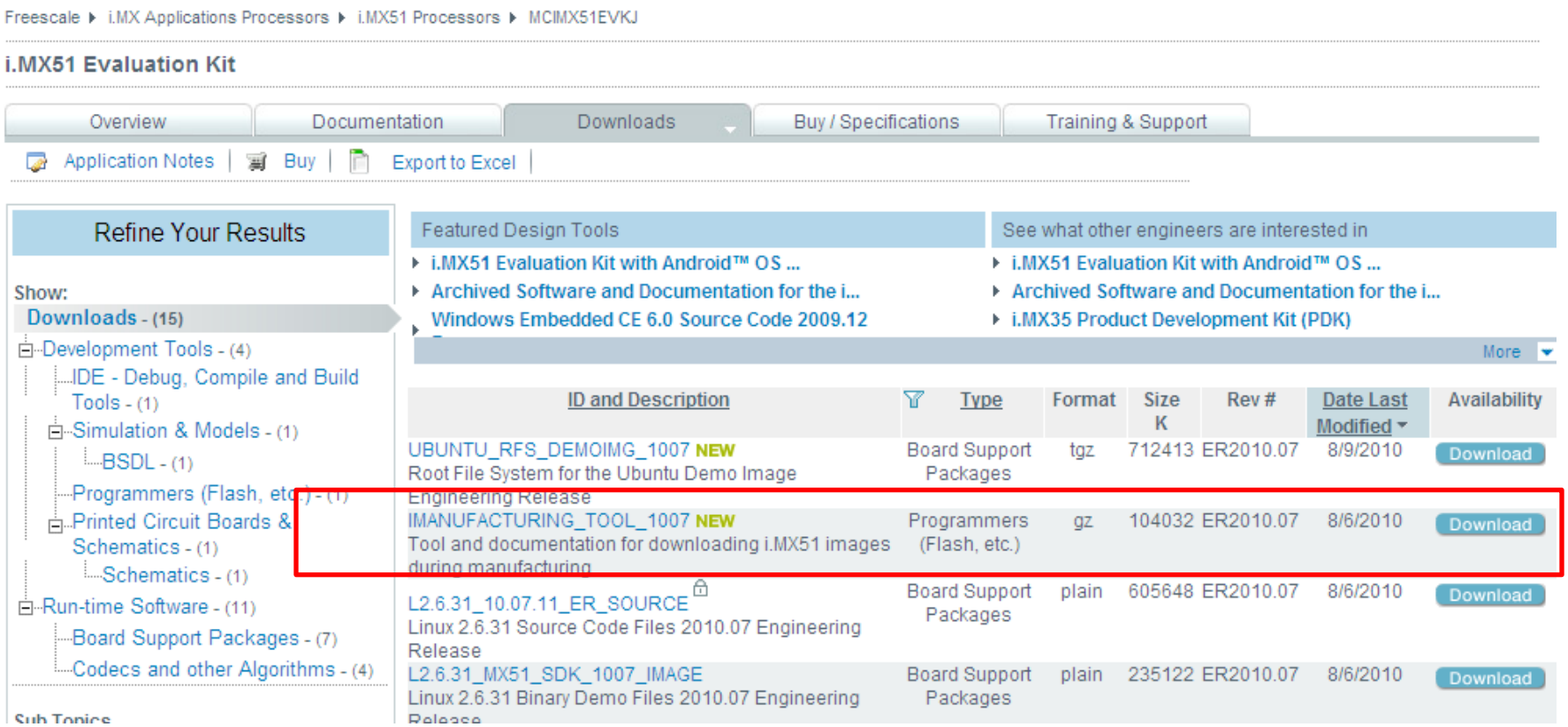
# Manufacturing Tool 10.07 on Freescale website

- http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MCIMX51EVKJ&nodeId=0162468rH31143ZrDR633B&fpsp=1&tab=Design_Tools_Tab



Freescale ▸ i.MX Applications Processors ▸ i.MX51 Processors ▸ MCIMX51EVKJ

**i.MX51 Evaluation Kit**

Overview | Documentation | Downloads | Buy / Specifications | Training & Support

Application Notes | Buy | Export to Excel

**Refine Your Results**

Show:

Downloads - (15)

- Development Tools - (4)
  - IDE - Debug, Compile and Build Tools - (1)
  - Simulation & Models - (1)
    - BSDL - (1)
  - Programmers (Flash, etc.) - (1)
  - Printed Circuit Boards & Schematics - (1)
    - Schematics - (1)
- Run-time Software - (11)
  - Board Support Packages - (7)
  - Codecs and other Algorithms - (4)

Sub Topics

**Featured Design Tools**

- i.MX51 Evaluation Kit with Android™ OS ...
- Archived Software and Documentation for the i...
- Windows Embedded CE 6.0 Source Code 2009.12

**See what other engineers are interested in**

- i.MX51 Evaluation Kit with Android™ OS ...
- Archived Software and Documentation for the i...
- i.MX35 Product Development Kit (PDK)

More

| ID and Description | Type | Format | Size K | Rev # | Date Last Modified | Availability |
|---|---|---|---|---|---|---|
| UBUNTU_RFS_DEMOIMG_1007 NEW<br>Root File System for the Ubuntu Demo Image Engineering Release | Board Support Packages | tgz | 712413 | ER2010.07 | 8/9/2010 | Download |
| IMANUFACTURING_TOOL_1007 NEW<br>Tool and documentation for downloading i.MX51 images during manufacturing | Programmers (Flash, etc.) | gz | 104032 | ER2010.07 | 8/6/2010 | Download |
| L2.6.31_10.07.11_ER_SOURCE<br>Linux 2.6.31 Source Code Files 2010.07 Engineering Release | Board Support Packages | plain | 605648 | ER2010.07 | 8/6/2010 | Download |
| L2.6.31_MX51_SDK_1007_IMAGE<br>Linux 2.6.31 Binary Demo Files 2010.07 Engineering Release | Board Support Packages | plain | 235122 | ER2010.07 | 8/6/2010 | Download |

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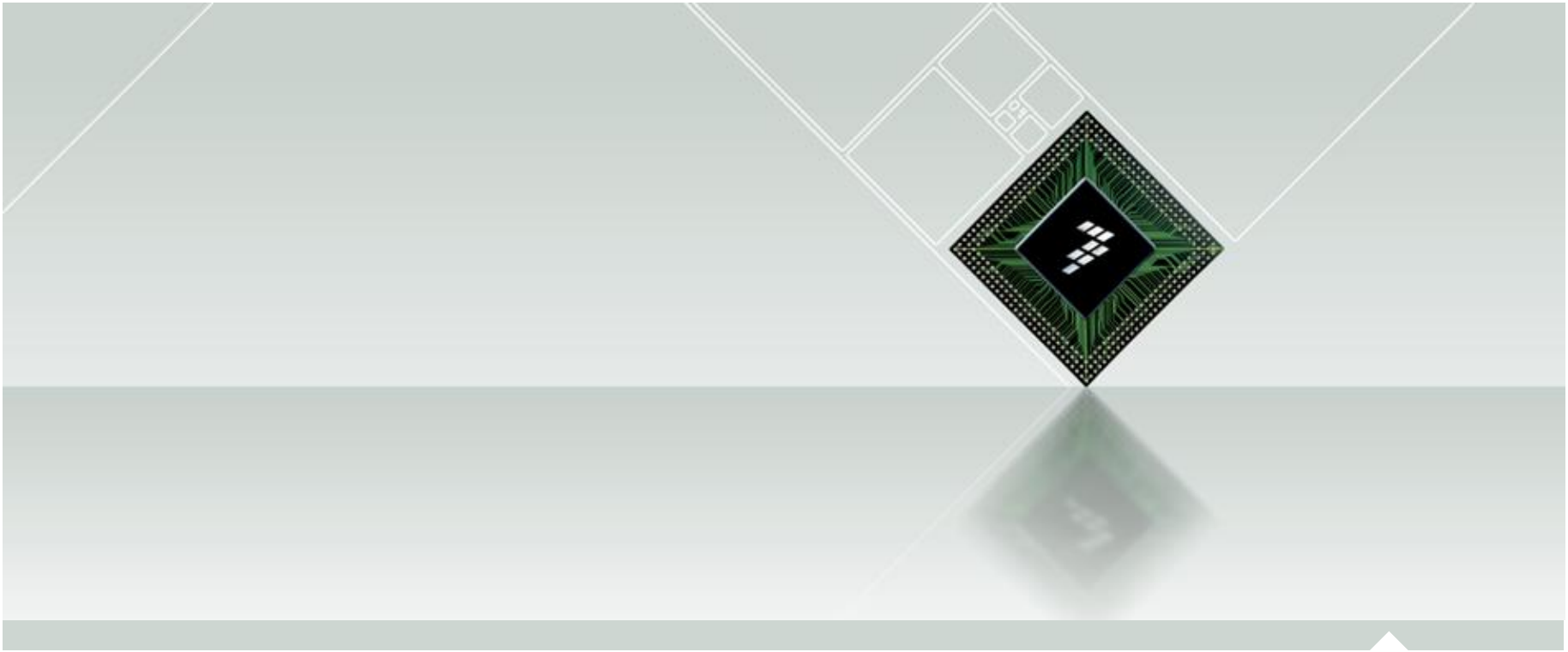

# Bootloaders

## Redboot and U-Boot

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# Typical Role of Bootloader

- Provides the first executable code when the board comes out of reset
  - In most cases – not the case on i.MX51EVK
- Initializes the processor and memory
  - Not 100% true for EVK
- Initializes additional devices (e.g. Ethernet)
- Provides a command interpreter for configuration
- Loads Linux into memory, passes parameters and transfers execution to the kernel

- Additional Features:
  - Supports transfer of images from host to target
  - Programs flash
  - Executes additional programs or scripts

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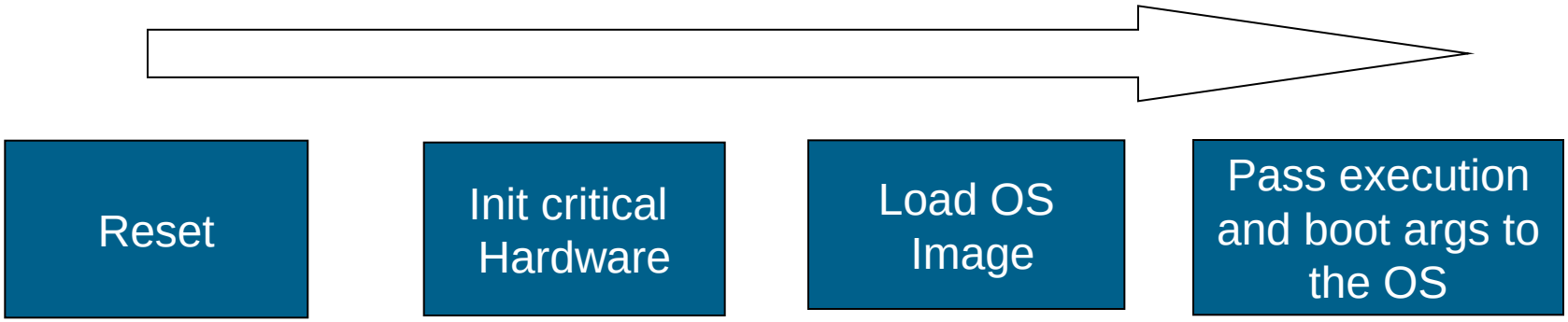
# Bootloader

- The bootloader provides early initialization code so the system is able to boot the OS. A typical run cycle for an embedded system bootloader:

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# i.MX Bootloaders

- REDBOOT – the *Stalwart* Bootloader Freescale uses on i.MX

  - Supports Flash File System
  - Supports Ethernet
  - Manipulation of i.MX locks
  - Can Blow/Read E-Fuses
  - Can Read/Write/Erase SPI flash
  - Can Manipulate PMIC registers (Useful for hardware bring up)
  - Supports NAND, SD/MMC, Nor

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# i.MX Bootloaders … Redboot

- Bootloader development is *ASYNCRONOUS* with SDK releases
- Unlike U-Boot (coming up next), Redboot is *DECOUPLED* from build environment
- Use the ZIP file of Redboot that comes in the SDK_SOURCE download discussed earlier
- Now to the redboot_201003.zip package …

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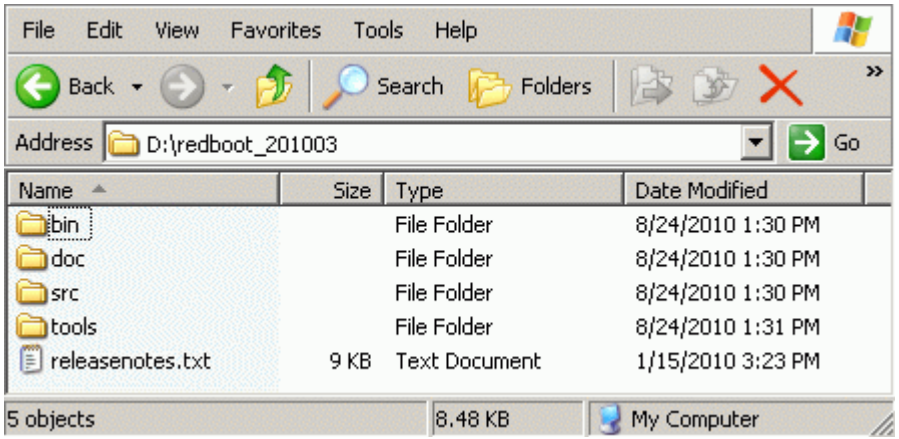
# Redboot Package

Binary prebuilt images

Documents for How to Build

Source used in building

Compilers and JTAG INIT scripts


File Edit View Favorites Tools Help
Back Search Folders
Address D:\redboot_201003
Go
Name Size Type Date Modified
bin File Folder 8/24/2010 1:30 PM
doc File Folder 8/24/2010 1:30 PM
src File Folder 8/24/2010 1:30 PM
tools File Folder 8/24/2010 1:31 PM
releasenotes.txt 9 KB Text Document 1/15/2010 3:23 PM
5 objects
8.48 KB
My Computer

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# Important Files in Redboot

- Hal_platform_setup.h in /packages/hal/arm/mx51/babbage/current/
- Although redboot can be built under Windows (using Cygwin) and Linux, a Linux host is recommended since you are already doing  Linux development
- There will be no additional enhancements moving forward for Redboot.  U-boot is now our defacto bootloader.
- Still useful features in Redboot such as Fuse Burning
- Can also use Redboot as a Basis to run eCos.  eCos is a small POSIX compliant Real Time Operating system.  Stands for Embedded Configurable Operating System
- See www.ecoscentric.com for more details.

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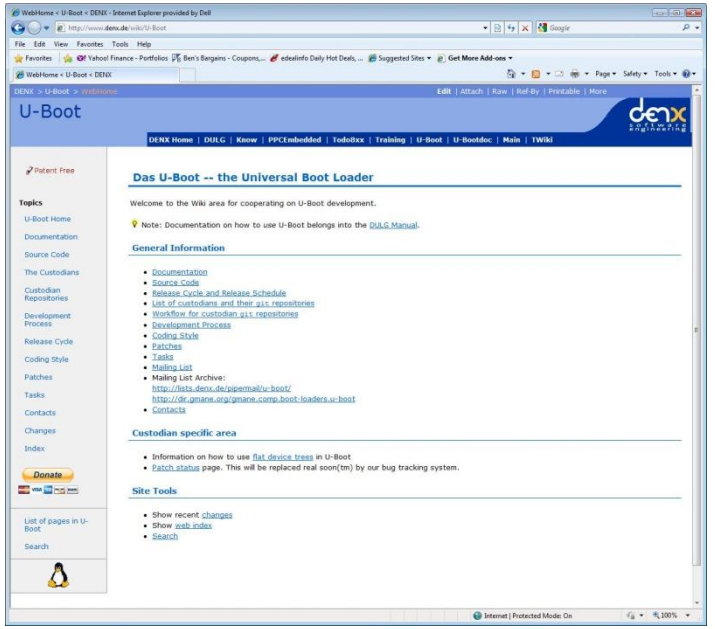
# UBOOT

- Very popular open source bootloader project by Denx. http://www.denx.de/wiki/U-Boot
- Support several architectures.
- Mature code, specific areas supported by different maintainers. http://www.denx.de/wiki/U-Boot/Custodians
- Well documented, start by the readme file.
- Getting the source:

  git://git.denx.de/u-boot or custodian tree.

  http://opensource.freescale.com/pub/scm/imx/uboot-imx.git
- BEST WAY? From Freescale BSP! (more Later)


U-Boot
Das U-Boot -- the Universal Boot Loader
Welcome to the Wiki area for cooperating on U-Boot development.
General Information
Custodian specific area
Site Tools

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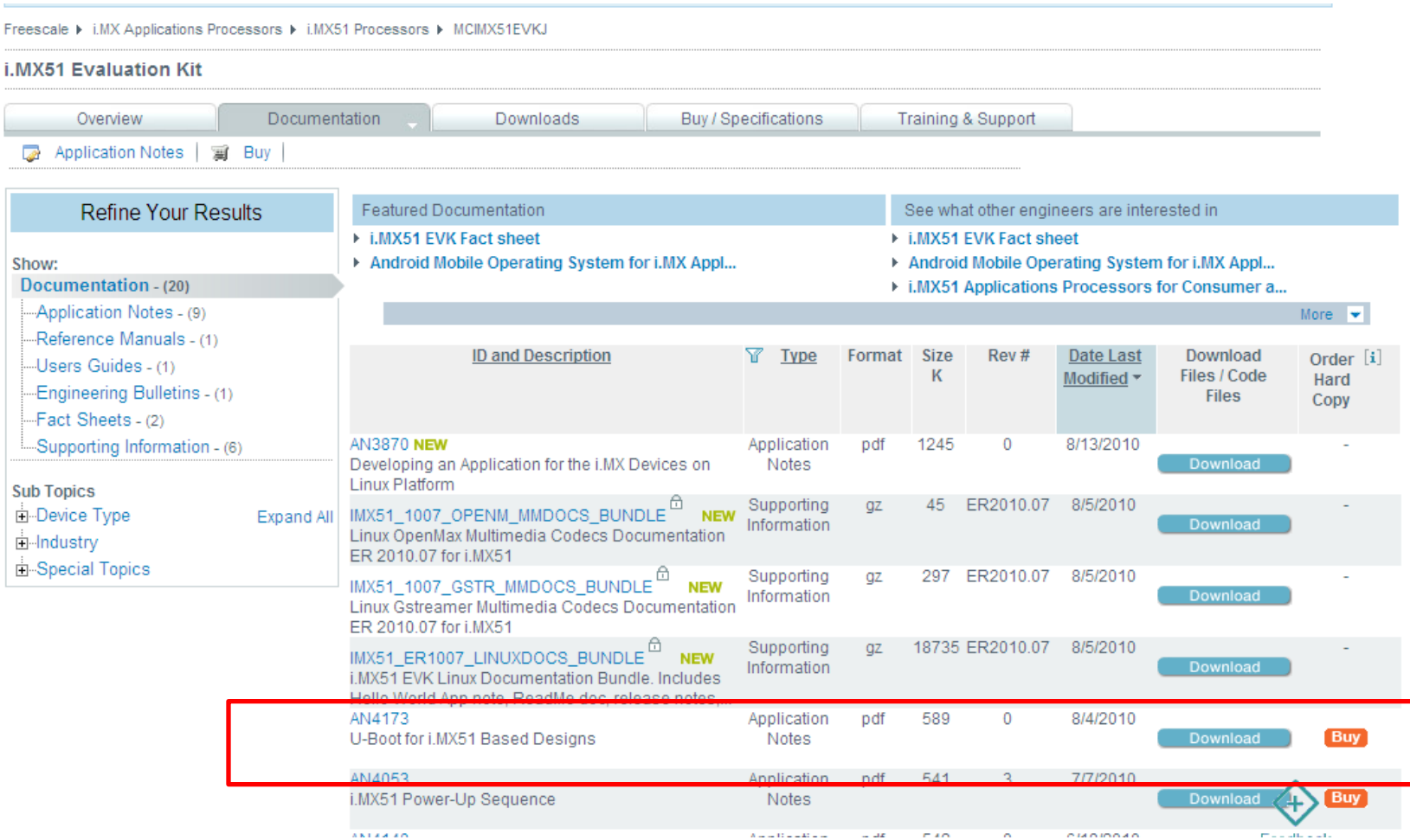
# U-Boot Porting Guide for i.MX51

- http://www.freescale.com/webapp/sps/site/prod_summary.jsp?code=MCIMX51EVKJ&nodeId=0162468rH31143ZrDR633B&fpsp=1&tab=Design_Tools_Tab

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# Working with U-Boot on Ltib

- Freescale provides an U-Boot port for its i.MX development boards.

- After installing LTIB, get U-Boot source:
  - Open terminal prompt from Desktop (Special Terminal Prompt!! It Sets Destination directory to Freescale LTIB for you)

    Type:
  - *./ltib –p u-boot –m prep*

- Source be extracted to rpm/BUILD/<respective package checked out>

- What just happened? Extracted U-boot from community, and “Patched” Freescales changes on top of it.

- View by changing to directory: cd rpm/BUILD/u-boot-2009.08

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# Working with U-Boot on Ltib

- Workflow would be:  (While in ltib directory)
  - ./ltib –p u-boot –m prep  (Check out source and Patch)
  - Make desired modifications to source
- Now Build It!
  - Up arrow (For last ./ltib command history)
  - *You will get ./ltib –p u-boot –m prep on the command line…..*
    *(Take advantage of the "Free" typing!!)*
  - *Change the last line of –m prep to –m scbuild  (Build Source)*
  - *Up arrow again / change scbuild to scdeploy  (Put u-boot bin in root File System)*
    *goes to <ltib_install_dir>/rootfs/boot*

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# Working with U-Boot on Ltib

- Lets Change the “U-boot” Prompt: (make sure your are in LTIB directory)
  - ./ltib –p u-boot –m prep (We already did this in a prior step don’t have to do)
  - Change to rpm/build/u-boot-2009.08 directory, then type:

    cd include/configs

    gedit mx51_bbg.h
  - search for “CONFIG_SYS_PROMPT” (Should be "BBG U-Boot > “ )
- Change to your liking….and save…..such as:
    - #define CONFIG_SYS_PROMPT “FTF_ROCKS>”
    - Change back to LTIB directory: cd ../../../
  - Up arrow 2 times (For last ./ltib command history)
  - *You will get ./ltib –p u-boot –m prep on the command line…..*
  - *Change the last line of –m prep above to –m scbuild*
  - *Up Arrow again, and change scbuild to scdeploy*

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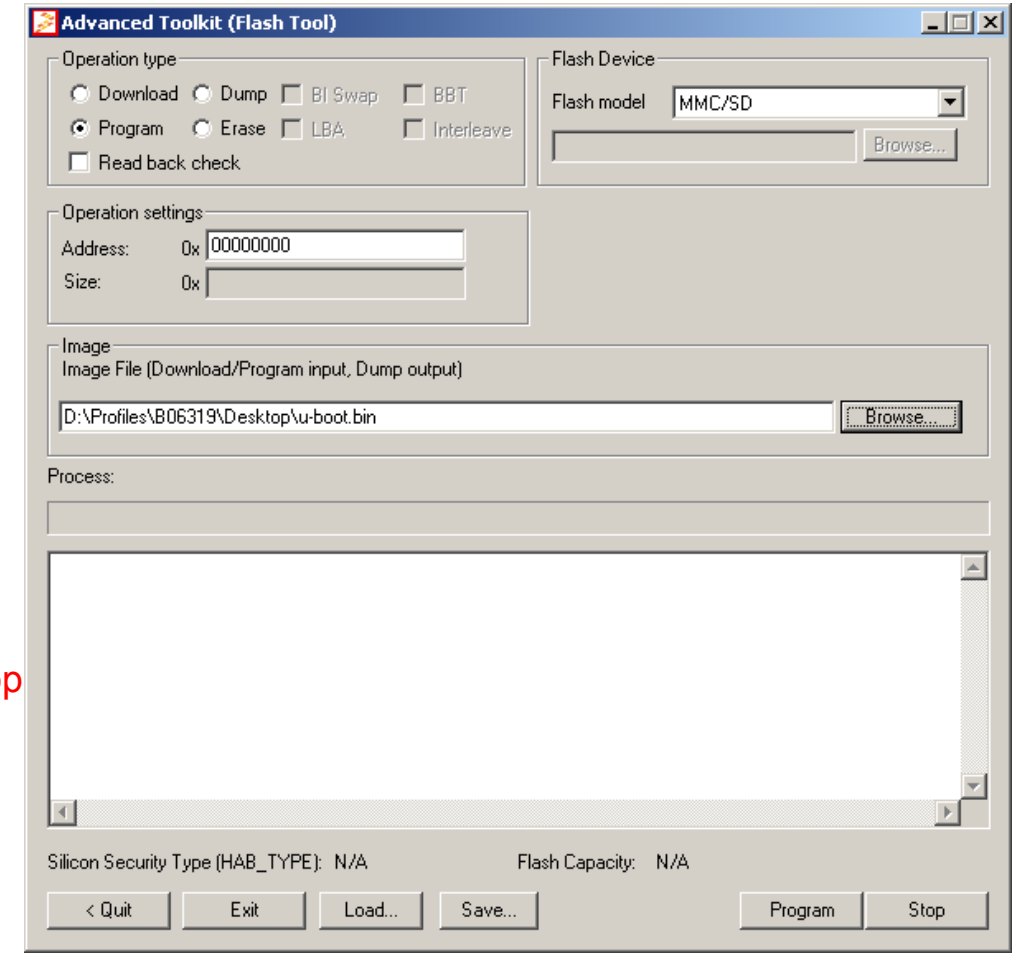
# Working with U-Boot on Ltib

- Lets Program with ATK
  - Follow same steps we did with Redboot
    - Power down board
    - First two switches on EVK up for USB/UART bootload mode
    - Built u-boot.bin ends up in rootfs/boot directory off the LTIB install dir
    - Click “Link to LTIB” icon on desktop
    - Doubleclick “rootfs”
    - Doubleclick “boot”
    - Drag the u-boot.bin file onto the Windows Desktop
    - Run ATK on DESKTOP and configure like shown.

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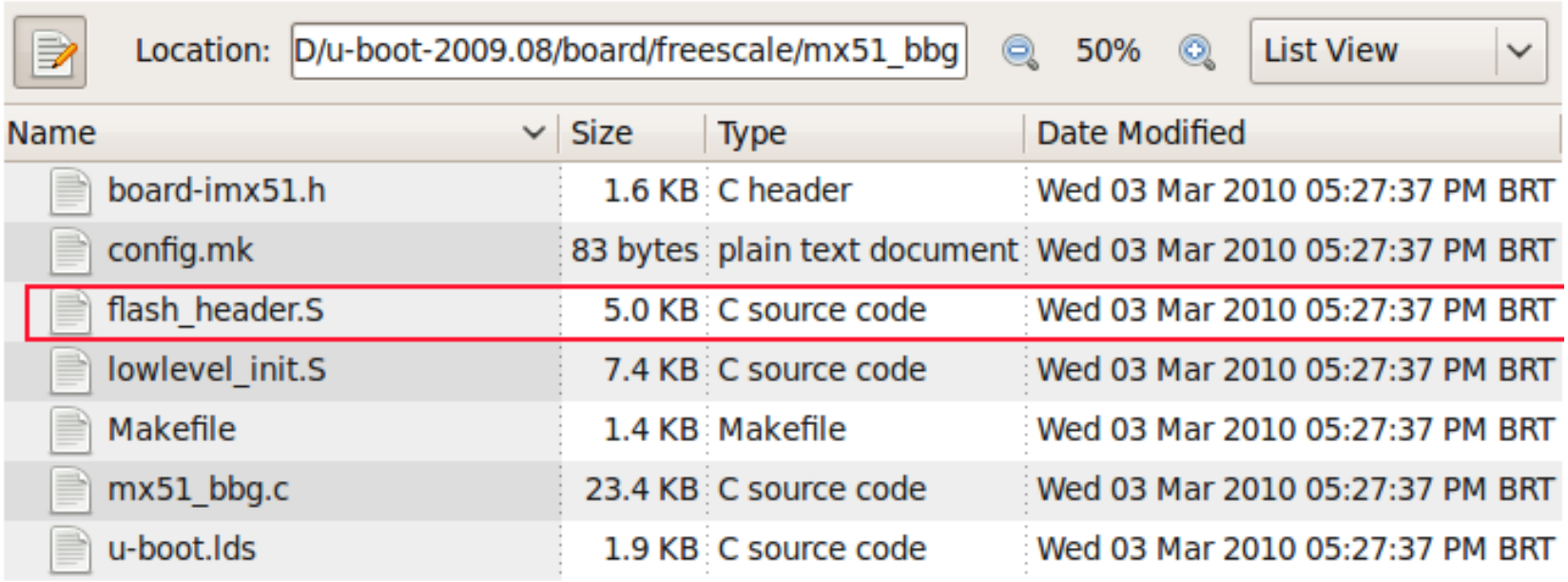
# Board Specific Files – “Board” Directory

- Some files that you should care about:


Location: D/u-boot-2009.08/board/freescale/mx51_bbg
50%
List View
Name
Size
Type
Date Modified
board-imx51.h 1.6 KB C header Wed 03 Mar 2010 05:27:37 PM BRT
config.mk 83 bytes plain text document Wed 03 Mar 2010 05:27:37 PM BRT
flash_header.S 5.0 KB C source code Wed 03 Mar 2010 05:27:37 PM BRT
lowlevel_init.S 7.4 KB C source code Wed 03 Mar 2010 05:27:37 PM BRT
Makefile 1.4 KB Makefile Wed 03 Mar 2010 05:27:37 PM BRT
mx51_bbg.c 23.4 KB C source code Wed 03 Mar 2010 05:27:37 PM BRT
u-boot.lds 1.9 KB C source code Wed 03 Mar 2010 05:27:37 PM BRT

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# DCD….VERY IMPORTANT!!!

- Its been mentioned before that the iMX51 doesn't follow traditional rules of a bootloader when it comes to init.
- It uses something called "DCD" to initialize the part. Flash_header.s implements this within U-boot
- This is where you would customize for different Memories!!!

flash_header.S (~/imx_linux_packages/imx51_09_12/ltib/rpm/...ILD/u-boot-2009.08/boa

File Edit View Search Tools Documents Help

New Open Save Print... Undo Redo Cut Copy Paste Find Replace

flash_header.S

```
        .word type                      ;       \
        .word addr                      ;       \
        .word val                       ;       \

.section ".text.flasheader", "x"
        b       _start
        .org    CONFIG_FLASH_HEADER_OFFSET
app_code_jump_v:        .word   _start
app_code_code_barker:   .word   CONFIG_FLASH_HEADER_BARKER
app_code_csf:           .word   0
dcd_ptr_ptr:            .word   dcd_ptr
super_root_key:         .word   0
dcd_ptr:                .word   dcd_array_start
app_dest_ptr:           .word   TEXT_BASE
dcd_array_start:
magic:                  .word   0xB17219E9
dcd_array_size:         .word   dcd_data_end - dcd_array_start - 8
/* DCD */
/* DDR2 IOMUX configuration */
MXC_DCD_ITEM(1, 4, IOMUXC_BASE_ADDR + 0x8a0, 0x200)
MXC_DCD_ITEM(2, 4, IOMUXC_BASE_ADDR + 0x50c, 0x20c5)
MXC_DCD_ITEM(3, 4, IOMUXC_BASE_ADDR + 0x510, 0x20c5)
MXC_DCD_ITEM(4, 4, IOMUXC_BASE_ADDR + 0x83c, 0x2)
MXC_DCD_ITEM(5, 4, IOMUXC_BASE_ADDR + 0x848, 0x2)
MXC_DCD_ITEM(6, 4, IOMUXC_BASE_ADDR + 0x4b8, 0xe7)
```

C Tab Width: 8 Ln 1, Col 1 INS

**Table 2-18. Flash Header Offset**

| Flash Type | Base Address Offset |
|---|---|
| NOR | 4 Kbyte = 0x1000 bytes |
| NAND | 1 Kbyte = 0x400 bytes |
| OneNAND | 256 bytes = 0x100 bytes |
| SD/MMC/eSD/eMMC | 1 Kbyte = 0x400 bytes |
| I2C/HS-I2C/SPI EEPROM | 1 Kbyte = 0x400 bytes |

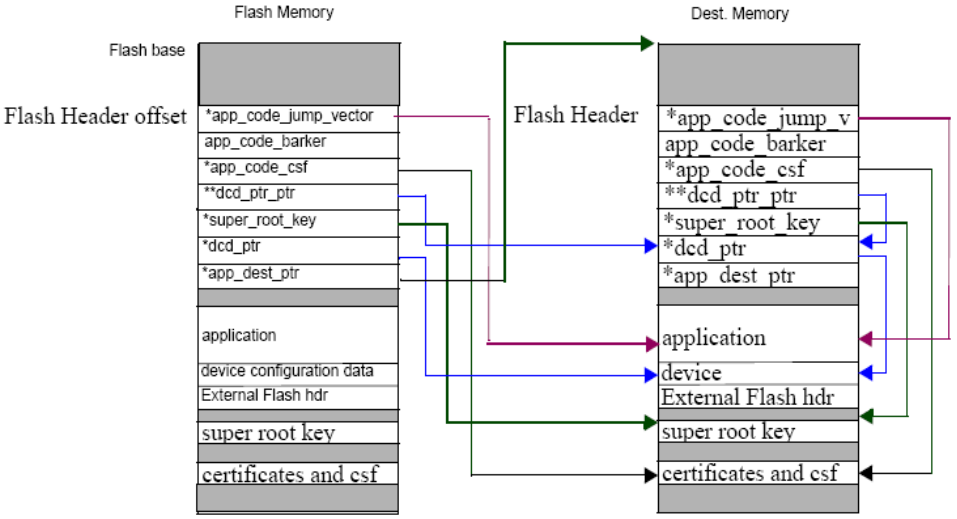


**Figure 2-9. Flash Header Data Structure**

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# Board Specific Files - “include/configs/mx51_bbg.h”

- The board configuration file: (Memory Size, Baud Rates, Prompt ETC)

```
#include <asm/arch/mx51.h>

 /* High Level Configuration Options */
#define CONFIG_ARMV7            1     /* This is armv7 Cortex-A8 CPU core */
#define CONFIG_L2_OFF

#define CONFIG_MXC              1
#define CONFIG_MX51_BBG         1     /* in a mx51 */
#define CONFIG_FLASH_HEADER     1
#define CONFIG_FLASH_HEADER_OFFSET 0x400
#define CONFIG_FLASH_HEADER_BARKER 0xB1

#define CONFIG_SKIP_RELOCATE_UBOOT

#define CONFIG_MX51_HCLK_FREQ 24000000    /* RedBoot says 26MHz */

#define CONFIG_ARCH_CPU_INIT
#define CONFIG_ARCH_MMU

#define CONFIG_DISPLAY_CPUINFO
#define CONFIG_DISPLAY_BOARDINFO

#define BOARD_LATE_INIT
```

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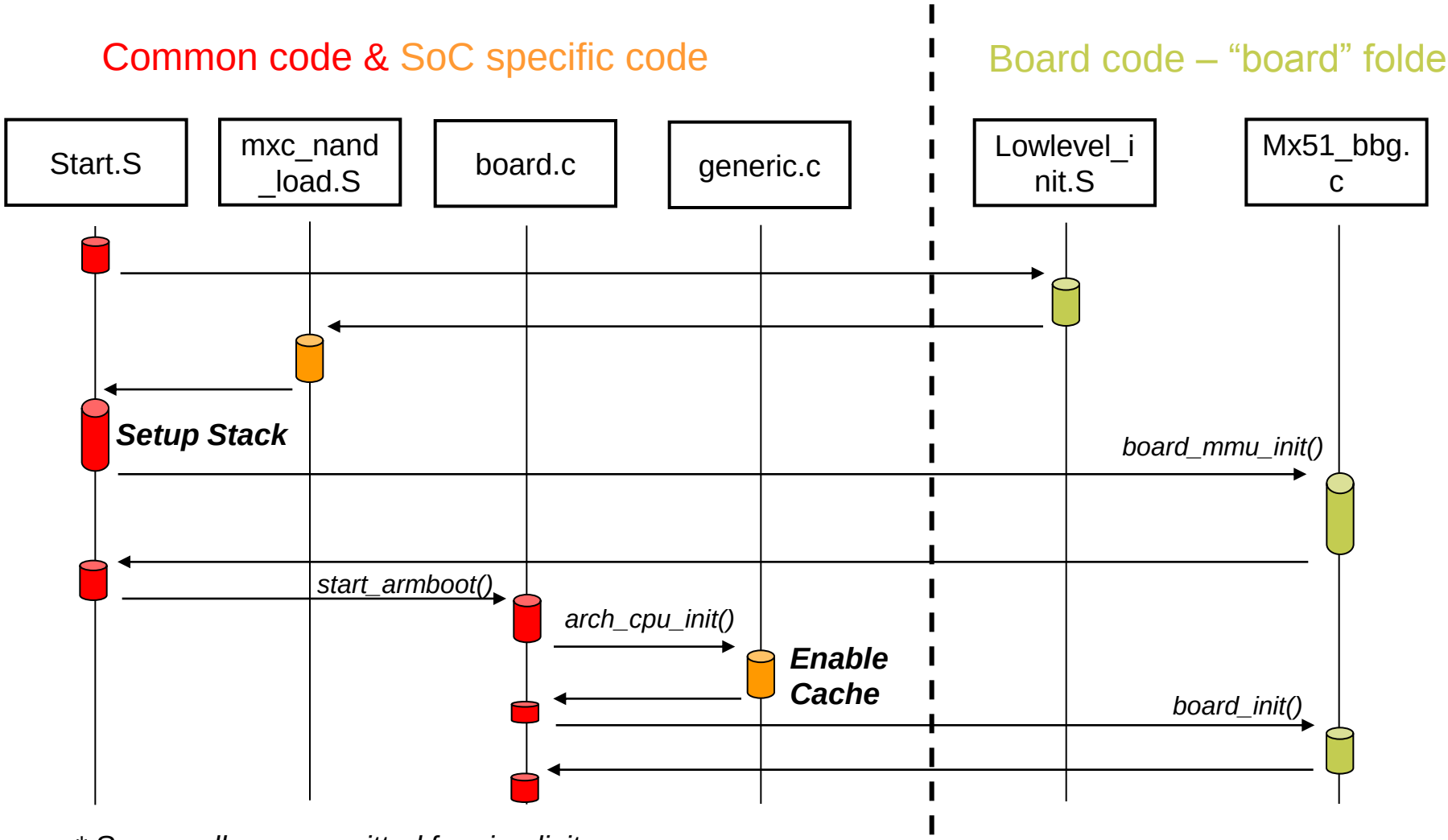
# Code Walkthrough – Execution Flow 1/2 *




** Some calls were omitted for simplicity*

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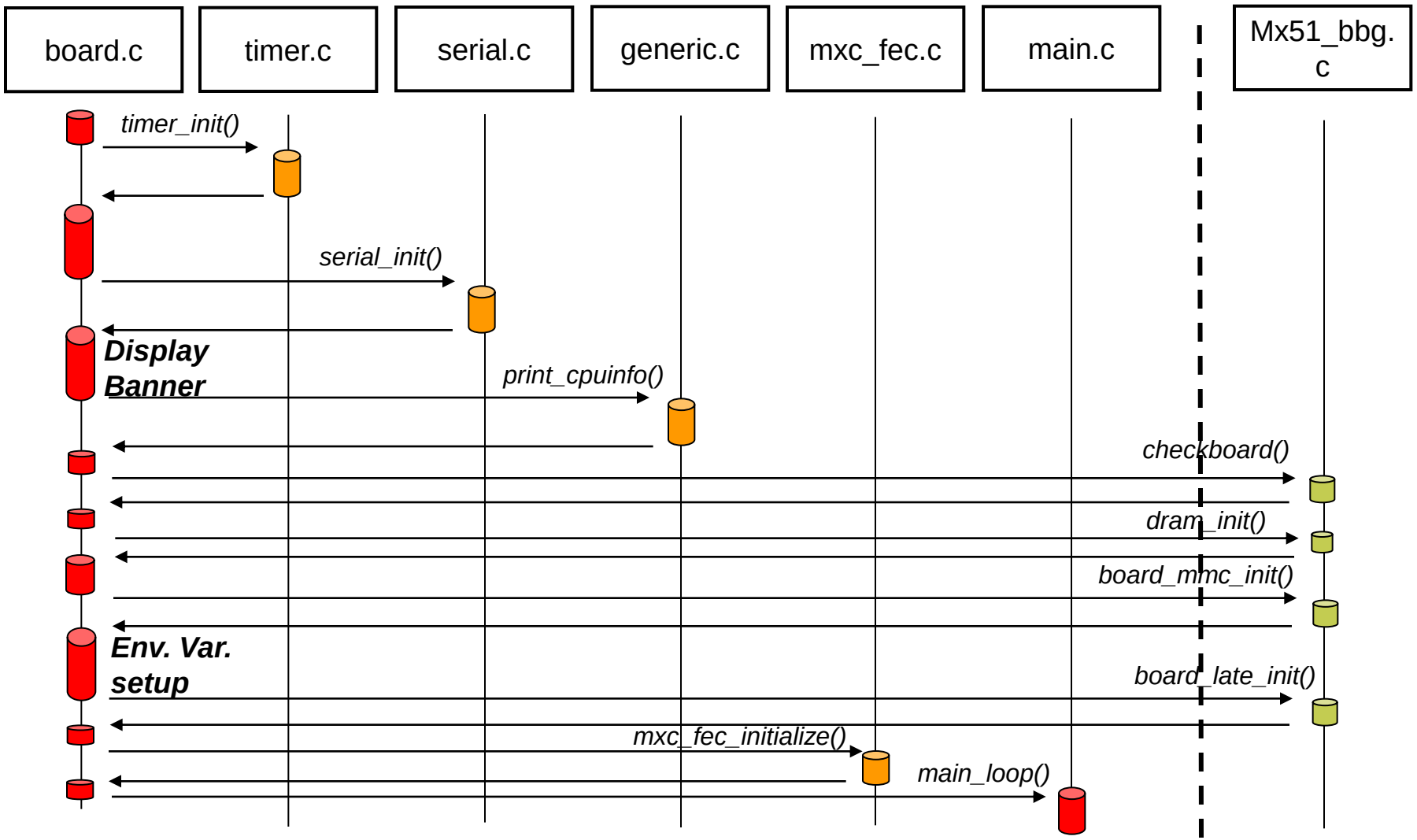
# Code Walkthrough - Execution Flow 2/2




** Some calls were omitted for simplicity*

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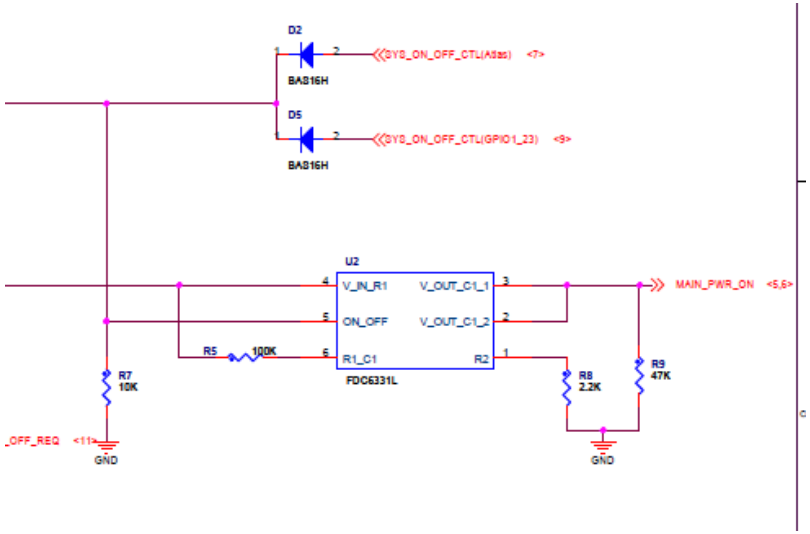
# Code Walkthrough – The first board specific call

- board\freescale\mx51_bbg\lowlevel_init.S

```
.globl lowlevel_init
lowlevel_init:
        ldr r0, =GPIO1_BASE_ADDR
        ldr r1, [r0, #0x0]
        orr r1, r1, #(1 << 23)
        str r1, [r0, #0x0]
        ldr r1, [r0, #0x4]
        orr r1, r1, #(1 << 23)
        str r1, [r0, #0x4]
        …
```

*GPIO1_23 controls the ON_OFF signal*

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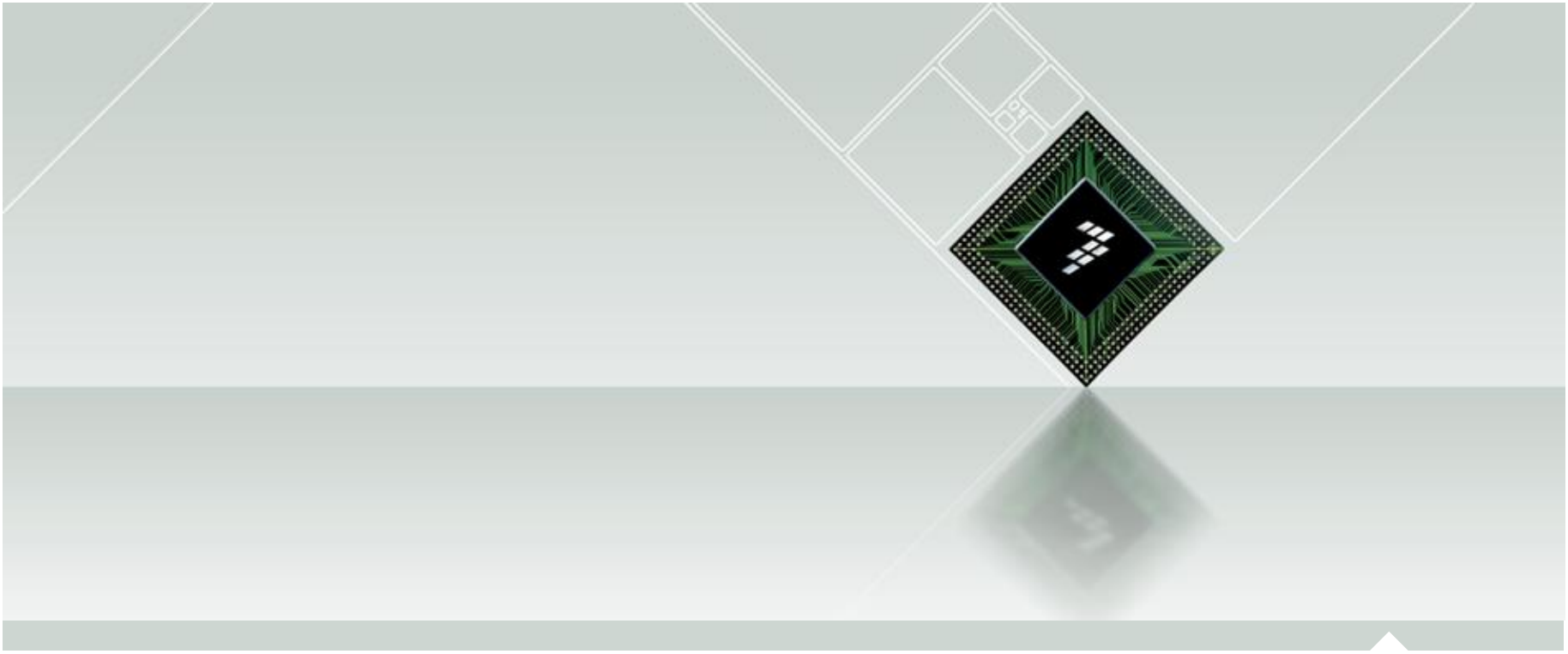

# LTIB – Linux Target Image Builder

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# LTIB

- **Freescale GNU/Linux Target Builder** is an Open Source tool used to build Linux target images composed of a set of packages.
- LTIB has been released under the terms of the **GNU General Public License** (GPL)
- LTIB BSPs draw packages from a common pool. Requirements:

1. Cross compiler
2. Bootloader sources
3. Kernel sources
4. Kernel configuration
5. Busybox.config file
6. Top level config file (main.lkc)
7. BSP config file (defconfig)

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# LTIB (cont)

- LTIB provides a lightweight command line interface to Perl scripts and LKC-syntax configuration menus to perform the following functions:
  - Build kernel, boot loader and application packages from source
  - Deploy built packages to a root file system (RFS)
  - Prepare appropriate kernel or RFS image file ready for network or flash based use on the embedded target board
  - Package management, including creation of board/arch specific RPM for installing a package into the RFS and patch generation for package source modifications

- LTIB assumes operation on packages with little change
  - If a package requires significant modifications (e.g. when porting a Linux kernel):
    - Check out the source
    - Build and test with standard development tools
    - Reintroduce source code changes, and
    - Consolidate them as a patch

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# LTIB (cont)

- LTIB performs all package configuration, build and installation tasks that normally would take place on a self-hosted Linux platform using build tools and RPM.

  However, it does so ***on the host machine***!

- Conceptually running LTIB means ***updating the Root FS*** for the target platform including the boot loader and kernel.

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# Reference Only!– Installing and Preparing LTIB

- Install the following packages:

```
$ sudo apt-get install g++ zlib1g-dev ncurses-dev rpm m4 bison patch tcl
$ sudo apt-get install libgtk2.0-dev libdbus-glib-1-dev liborbit2-dev intltool fbset
```

  - The first set of packages install and run LTIB.
  - The second set successfully builds the Gnome Mobile profile contained in several of the i.MX BSP's.
    - A bunch of additional packages also will be pulled in.
- Edit the */etc/sudoers* file to add the following line to the *User Privilege* section:

```
user ALL=NOPASSWD: /usr/bin/rpm, /opt/freescale/ltib/usr/bin/rpm
```

  - Edit this file using the *visudo* command: `$ sudo visodu`
  - Caution: Be careful editing this file as the system can be rendered unusable if *sudoers* files are accidentally moved or deleted.
- **There is a LTIB host setup guide for Linux Host PC running Ubuntu; which is in: *L2.6.31_10.07.11_ER_docs/ltib_build_host_setup.pdf***

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# Reference Only! – Installing and Preparing LTIB

- Get latest BSP from freescale.com/imx51evk (in *Downloads* tab)
  - Latest consolidated i.MX BSP is L2.6.31_09.12.00_SDK_source.tar.gz
- *untar* and *install*:

```
$ tar zxvf L2.6.31_10.07.11_ER_source.tar.gz
$ cd L2.6.31_10.07.11_ER_source
$ ./install
```

- From directory where LTIB is installed

```
$ ./ltib –m config
```

- At the first *menuconfig* screen, leave the default *Freescale i.MX reference boards*, *Exit* and *Save*
- At next *menuconfig* screen, select *i.mx51* and *min profile*, *Exit* and *Save*
- At next *menuconfig* screen, leave all defaults, *Exit* and *Save*

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# Linux helping hands

- Tab Completion is your friend. Start typing a file name, and hit TAB and it will fill in paths etc
- Everything is done in the “home” directory. This is /home/vmuser

  If you want to get back to this location quick, type: cd ~
- To learn your current directory, type: pwd
- Its very common to type commands over and over again. The Up Arrow is command history
- You can even search for a command by doing: CTRL-R and start typing the command. It will fill it in!
- If you type: history

  you will get a list of all typed commands. To execute one, type : !# (Where # is the command number you want to execute)

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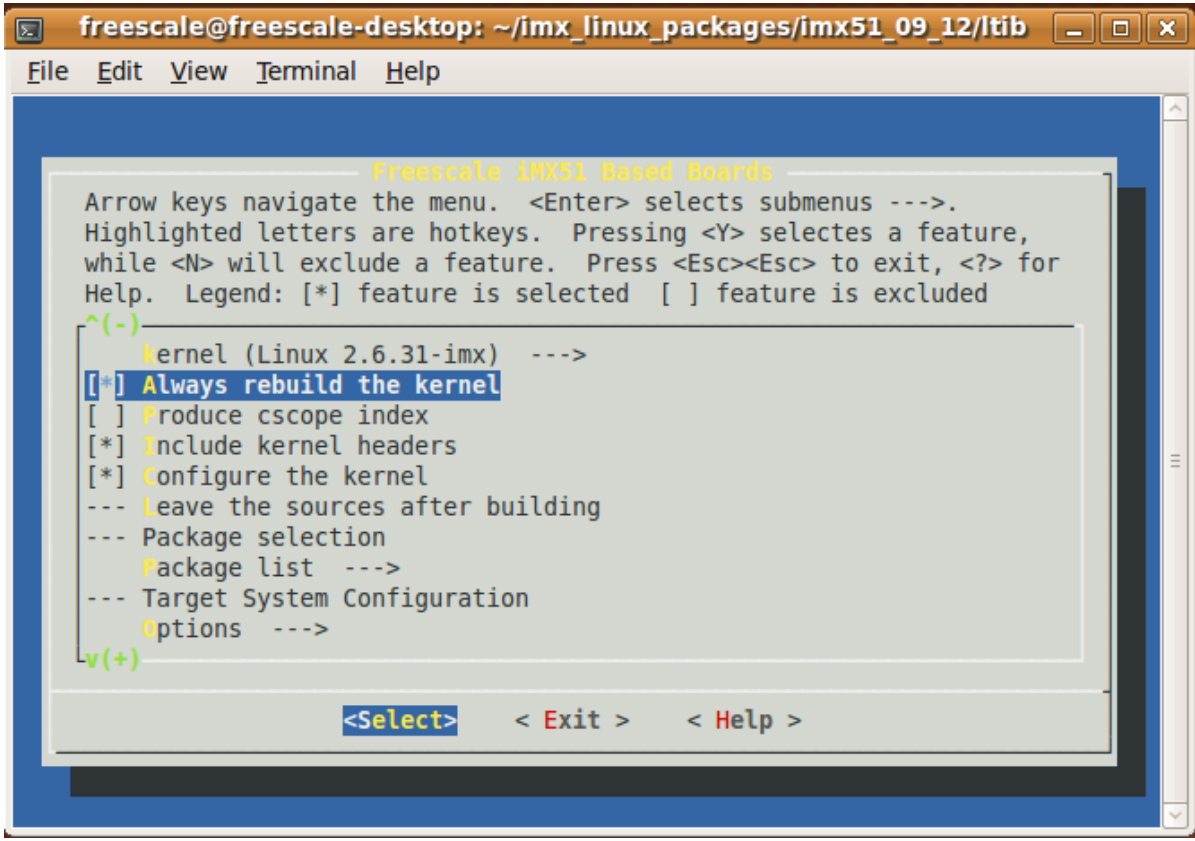
# Time to Build
## Demo

- Open the "LTIB_TERMINAL" window on desktop
- ./ltib –c (-c means configure)
- Put an * next to *Always Rebuild Kernel*, *Configure the Kernel*


freescale@freescale-desktop: ~/imx_linux_packages/imx51_09_12/ltib
File Edit View Terminal Help
Freescale iMX51 Based Boards
Arrow keys navigate the menu. <Enter> selects submenus --->.
Highlighted letters are hotkeys. Pressing <Y> selectes a feature,
while <N> will exclude a feature. Press <Esc><Esc> to exit, <?> for
Help. Legend: [*] feature is selected [ ] feature is excluded
kernel (Linux 2.6.31-imx) --->
[*] Always rebuild the kernel
[ ] Produce cscope index
[*] Include kernel headers
[*] Configure the kernel
--- Leave the sources after building
--- Package selection
Package list --->
--- Target System Configuration
Options --->
<Select> < Exit > < Help >

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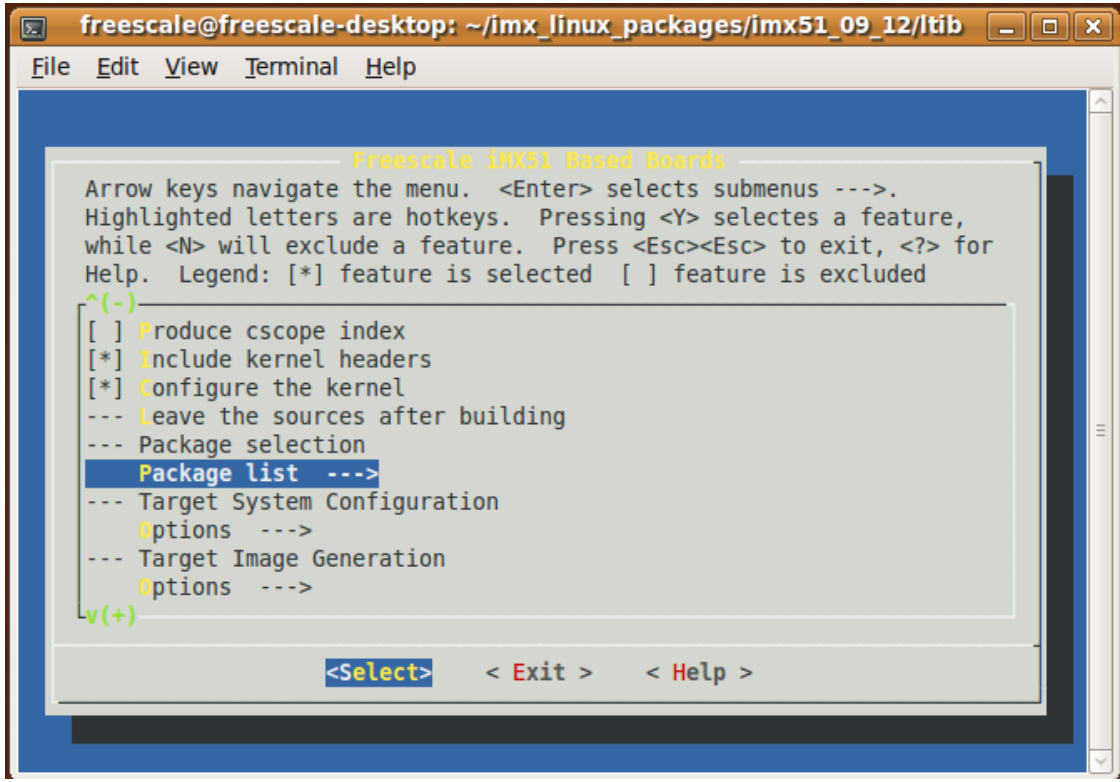
# LTIB Power Demo

- Select *Package List*

- A Linux system is comprised of two main entities:
  - Kernel
  - File System

- The *Package List* is what produces the *File System*


freescale@freescale-desktop: ~/imx_linux_packages/imx51_09_12/ltib
File Edit View Terminal Help
Freescale iMX51 Based Boards
Arrow keys navigate the menu. <Enter> selects submenus --->.
Highlighted letters are hotkeys. Pressing <Y> selectes a feature,
while <N> will exclude a feature. Press <Esc><Esc> to exit, <?> for
Help. Legend: [*] feature is selected [ ] feature is excluded
[ ] Produce cscope index
[*] Include kernel headers
[*] Configure the kernel
--- Leave the sources after building
--- Package selection
Package list --->
--- Target System Configuration
Options --->
--- Target Image Generation
Options --->
<Select> < Exit > < Help >

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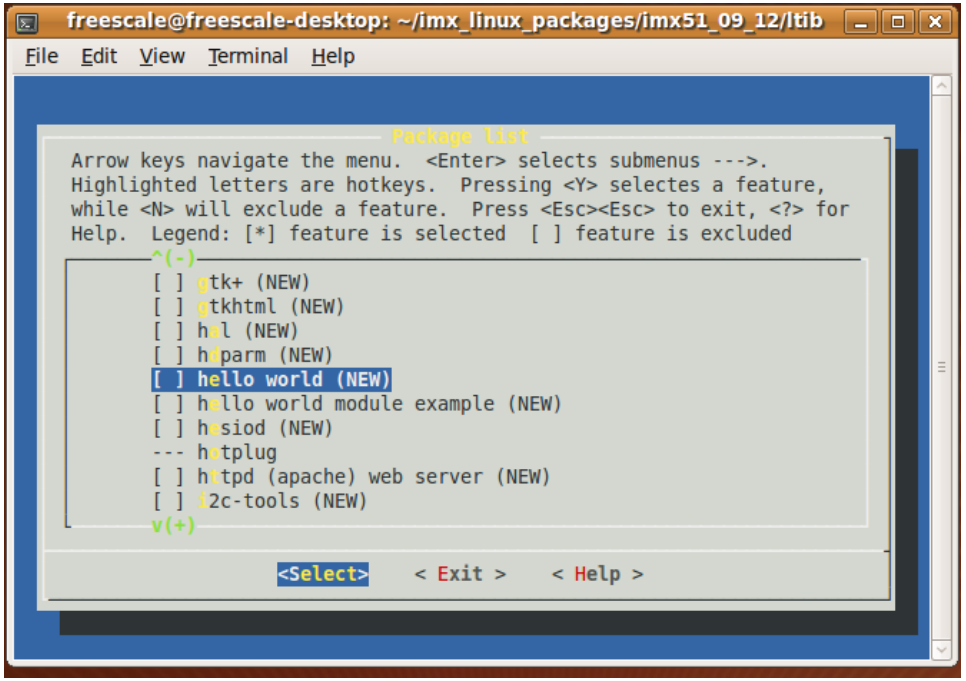
# Packages
# Demo

- Browse through the package list. Mostly made up of open source packages
- You can type “h” when a package is highlighted. It will show more details about that package. Try It
- Please Select the “hello world” by hitting the spacebar.
- Exit out of this menu


freescale@freescale-desktop: ~/imx_linux_packages/imx51_09_12/ltib
File Edit View Terminal Help
Package list
Arrow keys navigate the menu. <Enter> selects submenus --->.
Highlighted letters are hotkeys. Pressing <Y> selectes a feature,
while <N> will exclude a feature. Press <Esc><Esc> to exit, <?> for
Help. Legend: [*] feature is selected [ ] feature is excluded
^(-)
[ ] gtk+ (NEW)
[ ] gtkhtml (NEW)
[ ] hal (NEW)
[ ] hdparm (NEW)
[ ] hello world (NEW)
[ ] hello world module example (NEW)
[ ] hsiod (NEW)
--- hotplug
[ ] httpd (apache) web server (NEW)
[ ] i2c-tools (NEW)
v(+)
<Select> < Exit > < Help >

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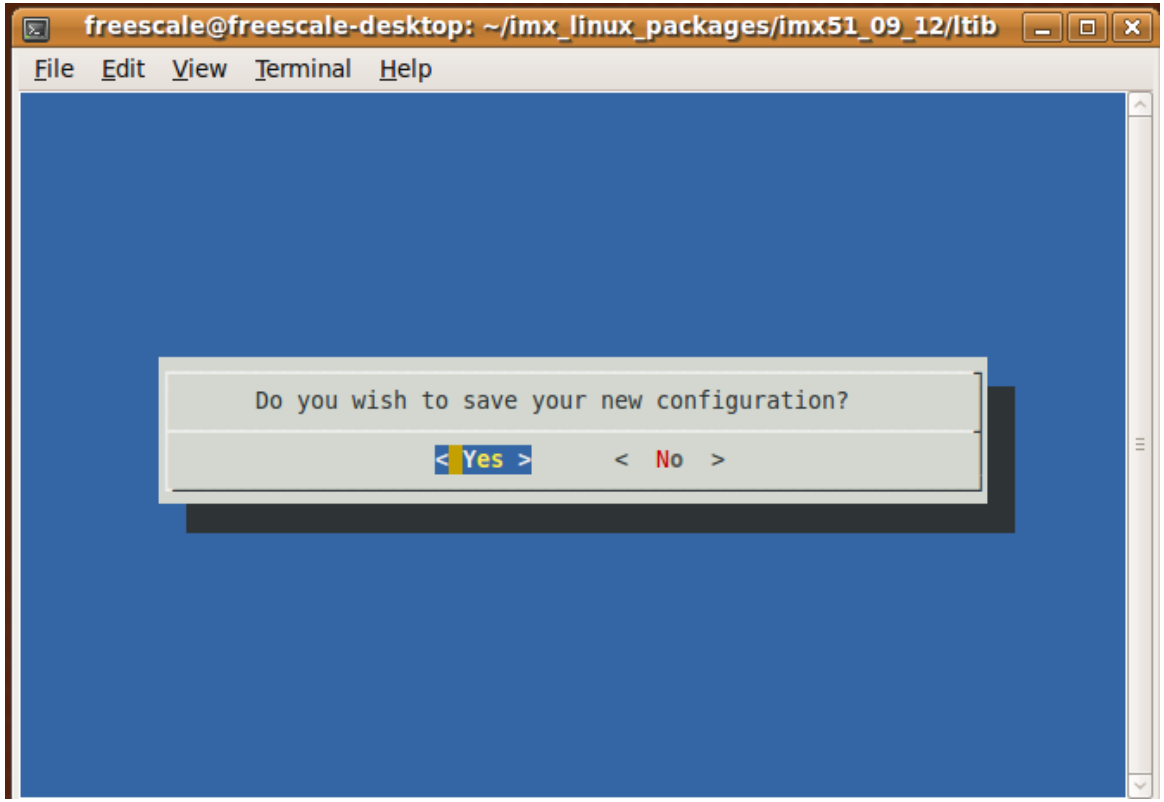
# Proceed with Build

- Continue to select *Exit* and click *Yes* to save configuration


freescale@freescale-desktop: ~/imx_linux_packages/imx51_09_12/ltib
File Edit View Terminal Help
Do you wish to save your new configuration?
< Yes >
< No >

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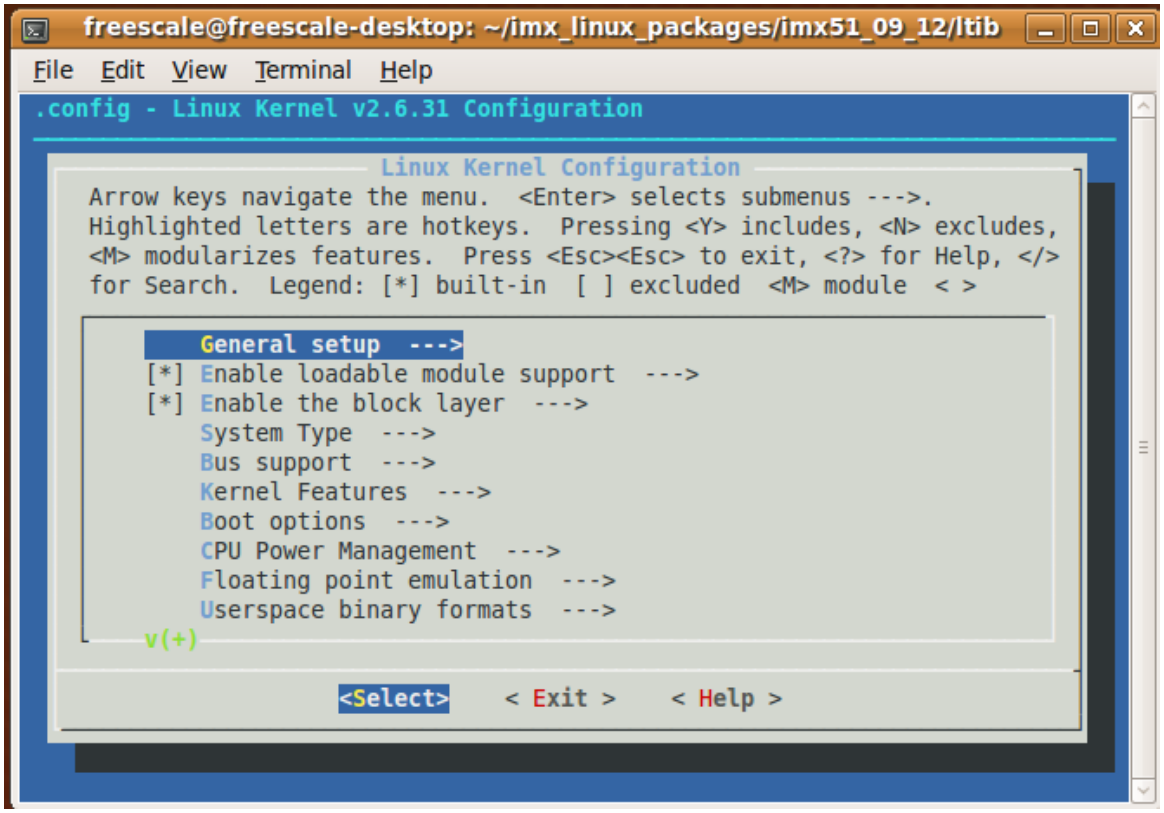
# Onto Kernel Configuration

- A bunch of text messages whirls by … and then *Kernel Config* appears


freescale@freescale-desktop: ~/imx_linux_packages/imx51_09_12/ltib
File Edit View Terminal Help
.config - Linux Kernel v2.6.31 Configuration
Linux Kernel Configuration
Arrow keys navigate the menu. <Enter> selects submenus --->.
Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes,
<M> modularizes features. Press <Esc><Esc> to exit, <?> for Help, </>
for Search. Legend: [*] built-in [ ] excluded <M> module < >
General setup --->
[*] Enable loadable module support --->
[*] Enable the block layer --->
System Type --->
Bus support --->
Kernel Features --->
Boot options --->
CPU Power Management --->
Floating point emulation --->
Userspace binary formats --->
v(+)
<Select> < Exit > < Help >

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# Exit Kernel Config

- Typical work flow – Make changes in *Kernel*, then *Exit*
- Kernel now builds
- LTIB has “Patched” various Freescale developed drivers onto the kernel.org downloaded kernel.

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# Other Ltib “Tips”

- Sometimes, it is desired to modify only one package. For example, the bootloader, U-Boot. (we already did this during the u-boot portion) Ltib allows for this with the “prep”, “scbuild” and “scdeploy”

- Workflow would be:
  - ./ltib –p u-boot –m prep (This checks out the source to /ltib/rpm/BUILD )
  - Make required source changes
  - ./ltib –p u-boot –m scbuild (This builds the source)
  - ./ltib –p u-boot –m scdeploy (This puts it in the rootfs directoy)

- You can find names of packages with:

  ./ltib –m listpkgs

- *‘sc’ in the above commands stands for “Short Circuit”*

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# Copying Bootloader, Kernel and Filesystem
## Demo

- When Linux finishes building, a Filesystem, Kernel Image, and Bootloader image will be created.
- The “rootfs” directory off the LTIB directory is actually destined for the target file system.
- The ltib/rootfs/boot directory will contain the bootloader and kernel images just built.
- We could put the bootloader, kernel and file system to a SD card and run the system via SD boot on i.MX51EVK

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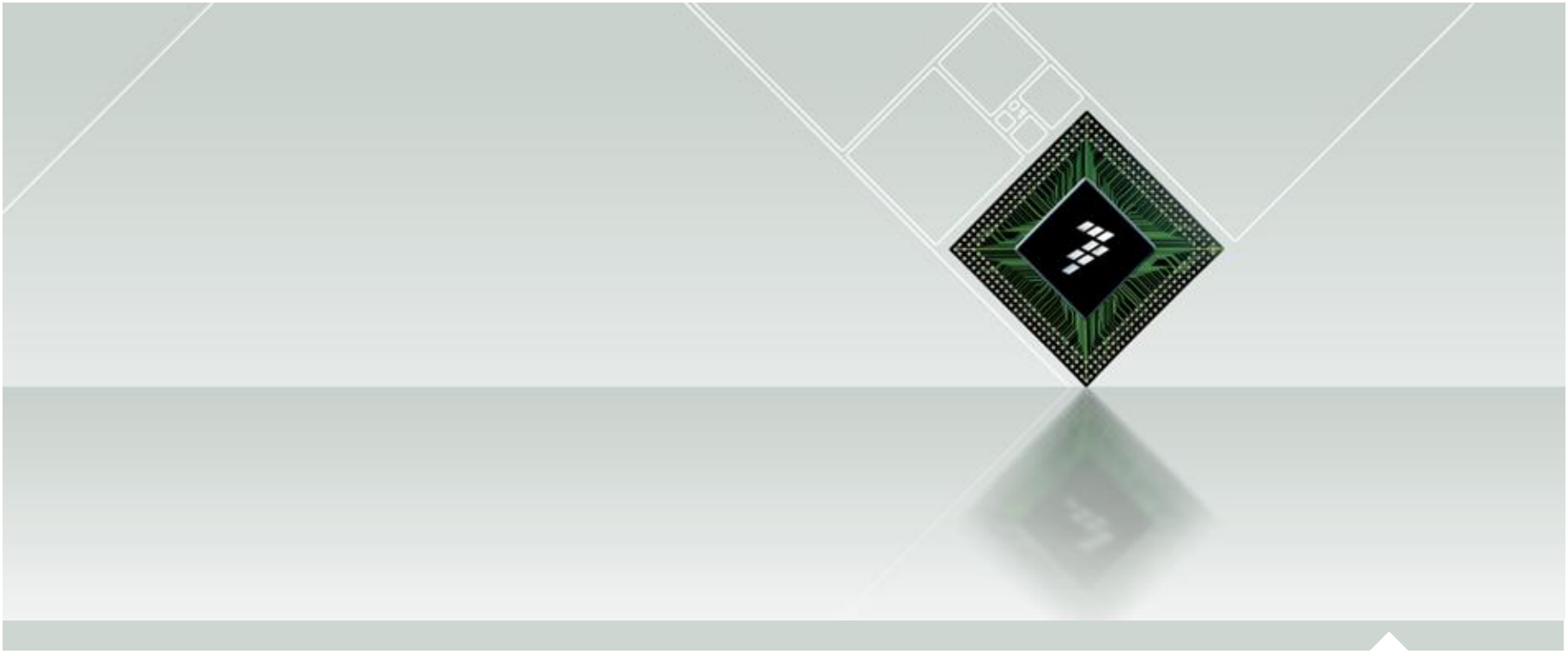

# Gstreamer

## Multimedia Framework Introduction and Demo

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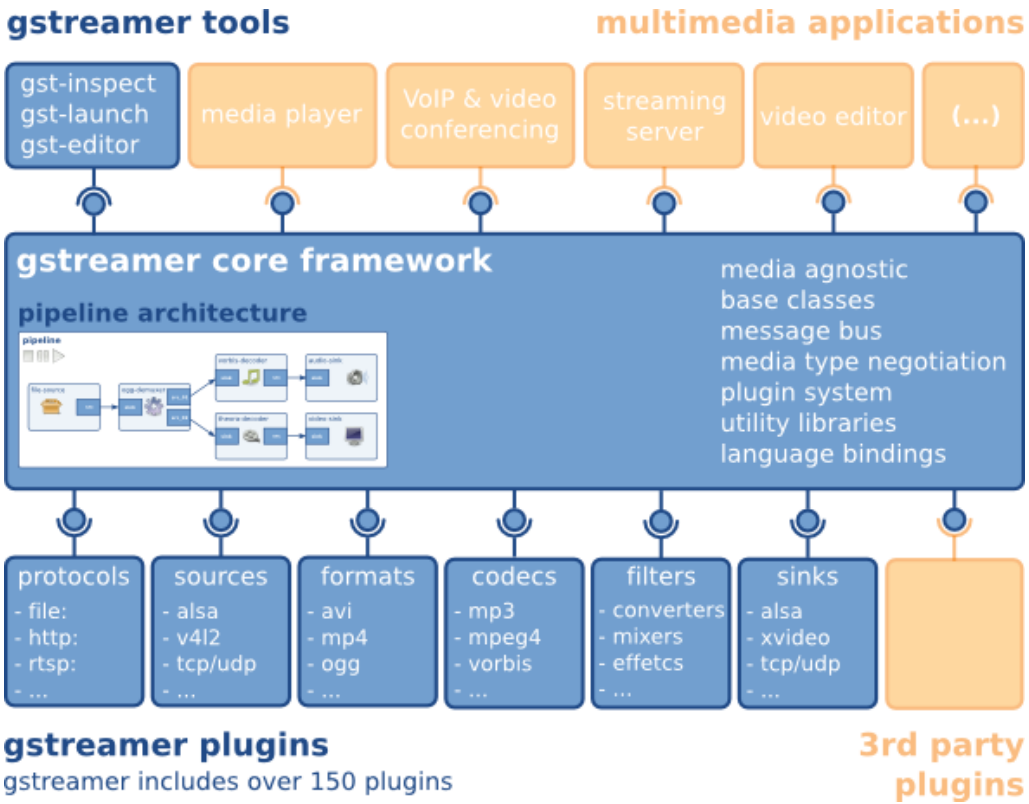
# Gstreamer Overview

- GStreamer is a framework for creating streaming media applications

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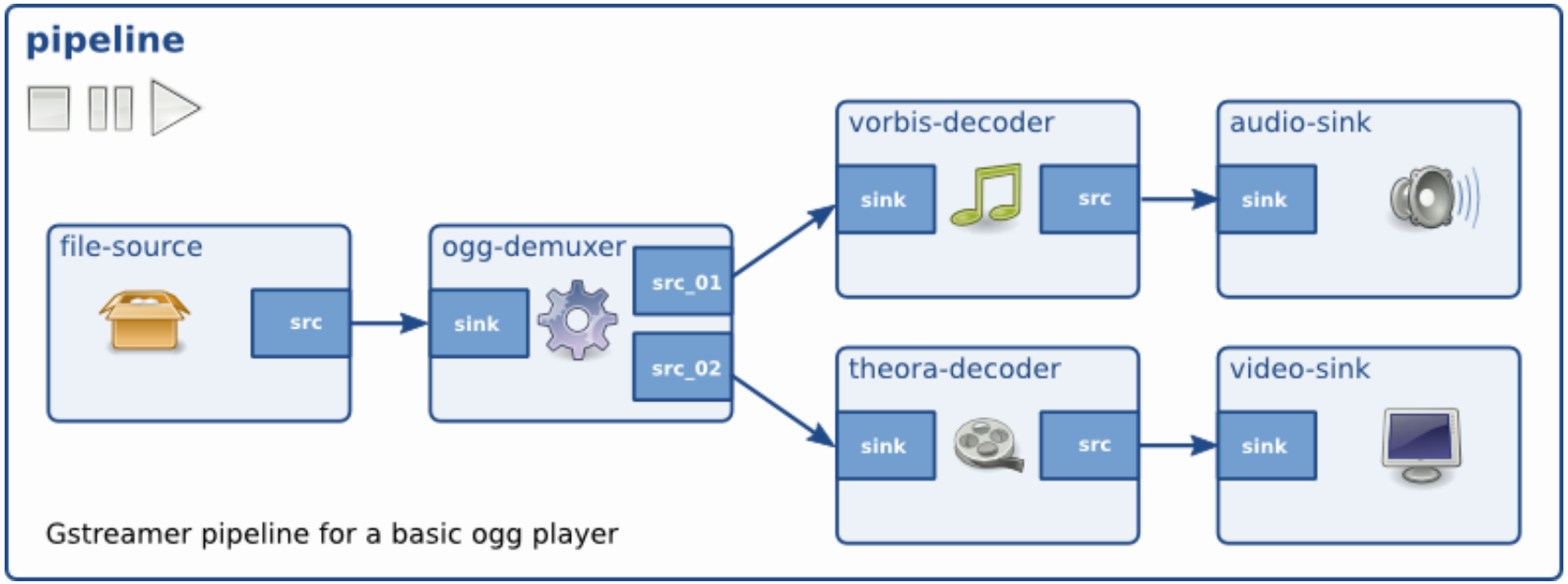
# Gstreamer Pipeline

- Example:

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# Gstreamer Terminology

- Definitions of Elements
  - Most important class of objects in GStreamer. Users create a chain of elements linked together and let data flow through this chain of elements.
  - One specific function … can be the reading of data from a file, decoding of this data or outputting this data to a sound card (or anything else).

- By chaining several such elements together, a pipeline is created that can do a specific task. For example: media playback or capture

- GStreamer ships with a large collection of elements by default making possible the development of a large variety of media applications.

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# Gstreamer Terminology

- Pads
  - Input and output of the elements that allows connection to other elements
  - Used to negotiate links and data flow between elements in GStreamer

- Bins and Pipelines
  - Bin – A container for a collection of elements
  - Pipeline – A special subtype of a bin that allows execution of all of its contained child elements
  - Since bins are subclasses of elements themselves. They can be controlled as if they were an element, thereby abstracting away application complexity.

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# Gstreamer Overview (cont)

- GStreamer is packaged into:
  - gstreamer: The core package
  - gst-plugins-base: An essential exemplary set of elements
  - gst-plugins-good: A set of good-quality plug-ins under LGPL
  - gst-plugins-ugly: A set of good-quality plug-ins that might pose distribution problems
  - gst-plugins-bad: A set of plug-ins that need more quality
  - gst-python: The python bindings
  - A few others packages
- Freescale Plugins!!! These are hardware accelerated plug ins that take advantage of the rich hardware accelerated blocks
- Separate download from same location as discussed at beginning of presentation.
- The one that shipped with 10.07 is called: ***MX5X_10.07_SS_MM_Standard_Source_Bundle.zip***
- There are instructions inside that file. Basically you put two of the files into /opt/freescale/pkgs
- Please refer to ***LINUX_MM_2010July_ER_LTIB_HOWTO.txt*** in Linux_Multimedia_Framework_Docs_MX51Ubuntu_1.9.0\docs for details

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# Basic Gstreamer Examples
## Demo

- Audio Test
  - *gst-launch-0.10 –v audiotestsrc ! alsasink*

- Video Test
  - For all of these tests, its possible that the “ECO FRIENDLY GREEN” features of our BSP become active. If you dont see a penguin on monitor before you type, please type the following:
    - *echo 0 > /sys/class/graphics/fb0/blank (Activates Monitor)*
    - *gst-launch-0.10 –v videotestsrc ! Autovideosink*
    - *Ctrl-c to exit*

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# Properties
## Demo

- To view *properties* of a plugin:

- *gst-inspect pluginname*

- Example:
  - *gst-inspect-0.10 | grep mfw*

- Changing the property:
  - *gst-launch-0.10 –v videotestsrc pattern=1 ! autovideosink*

*Try different numbers for the “Pattern”!!!*

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# Web Camera Loopback
## Demo

- UVC web camera is support in the current Linux Kernel

- Take the camera image and direct it to display
  - *gst-launch-0.10 v4l2src ! 'video/x-raw-yuv' ! mfw_v4lsink*
  - *gst-launch v4l2src ! 'video/x-raw-yuv,width=640,height=480' ! mfw_v4lsink*
  - *gst-launch v4l2src ! 'video/x-raw-yuv,width=320,height=240' ! mfw_v4lsink*

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# Audio Playback
## Demo

- MP3 playback
  - *gst-launch filesrc location=/music.mp3 ! queue max-size-time=0 ! mfw_mp3decoder ! audioconvert ! 'audio/x-raw-int, channels=2' ! alsasink*

- Playbin (it can play MP3, AAC, WMA, OGG, etc)
  - *gst-launch playbin uri=file:///music.mp3*

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# Playing a 720p Video Clip on DVI Monitor
## Demo

- Run the Gstreamer pipeline for playing MPEG4 720p video clip:
  - Video only:
    - *gst-launch filesrc location=/The_Future_of_Smart_Mobile_Devices.mp4 ! 'video/quicktime' ! aiurdemux name=demux demux. ! queue max-size-buffers=0 max-size-time=0 ! mfw_vpudecoder ! mfw_v4lsink &*
  - Video/Audio:
    - *gst-launch filesrc location=/The_Future_of_Smart_Mobile_Devices.mp4 ! 'video/quicktime' ! aiurdemux name=demux demux. ! queue max-size-buffers=0 max-size-time=0 ! mfw_vpudecoder ! mfw_v4lsink demux. ! queue max-size-buffers=0 max-size-time=0 ! mfw_aacplusdecoder ! audioconvert ! 'audio/x-raw-int, channels=2' ! Alsasink &*
- The 720p video displays on the DVI monitor at 720p resolution.
- Hit Enter, and Type: top….and Notice CPU utilization

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# Video Playback
## Demo

- Playbin
  - *cd /*
  - *gst-launch playbin uri=file:///The_Future_of_Smart_Mobile_Devices.mp4 &*

*Hit enter, and type "top" and hit enter.....*

*Note the CPU usage again*

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# Video Playback
## Demo

- gplay
  - *gplay /The_Future_of_Smart_Mobile_Devices.mp4 &*

*Much Easier, Huh?*

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# Video Playback
## Demo

- Playing WMV 720p video:

  - *gst-launch filesrc location=/Coral_Reef_Adventure_720.wmv ! mfw_asfdemuxer name=demux demux. ! queue max-size-buffers=0 max-size-time=0 ! mfw_vpudecoder ! mfw_v4lsink*

  - *gst-launch filesrc location=/Coral_Reef_Adventure_720.wmv ! mfw_asfdemuxer name=demux demux. ! queue max-size-buffers=0 max-size-time=0 ! mfw_vpudecoder ! mfw_v4lsink demux. ! queue max-size-buffers=0 max-size-time=0 ! mfw_wma10decoder ! audioconvert ! 'audio/x-raw-int, channels=2' ! alsasink*

  - *gst-launch playbin uri=file:///Coral_Reef_Adventure_720.wmv &*

  - *gplay /Coral_Reef_Adventure_720.wmv &*

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# GPU SDK

- Goal
  - To create, collect, and distribute a set of software, tools, and Documentation for our GPU hardware to facilitate customer education and product development
- Supporting Linux X11 and FBdev
- Samples
  - Linux fbdev and X11
    - OpenGL ES 1.1 and 2.0
      - NeHe OpenGL Tutorials
    - OpenVG
      - Tiger and ‘HMI’ Demo
    - C2D
      - Blit, Gradient, Rotation, etc.
- Demos
  - Full Source
    - 3DGUI (aka “The CES Demo)

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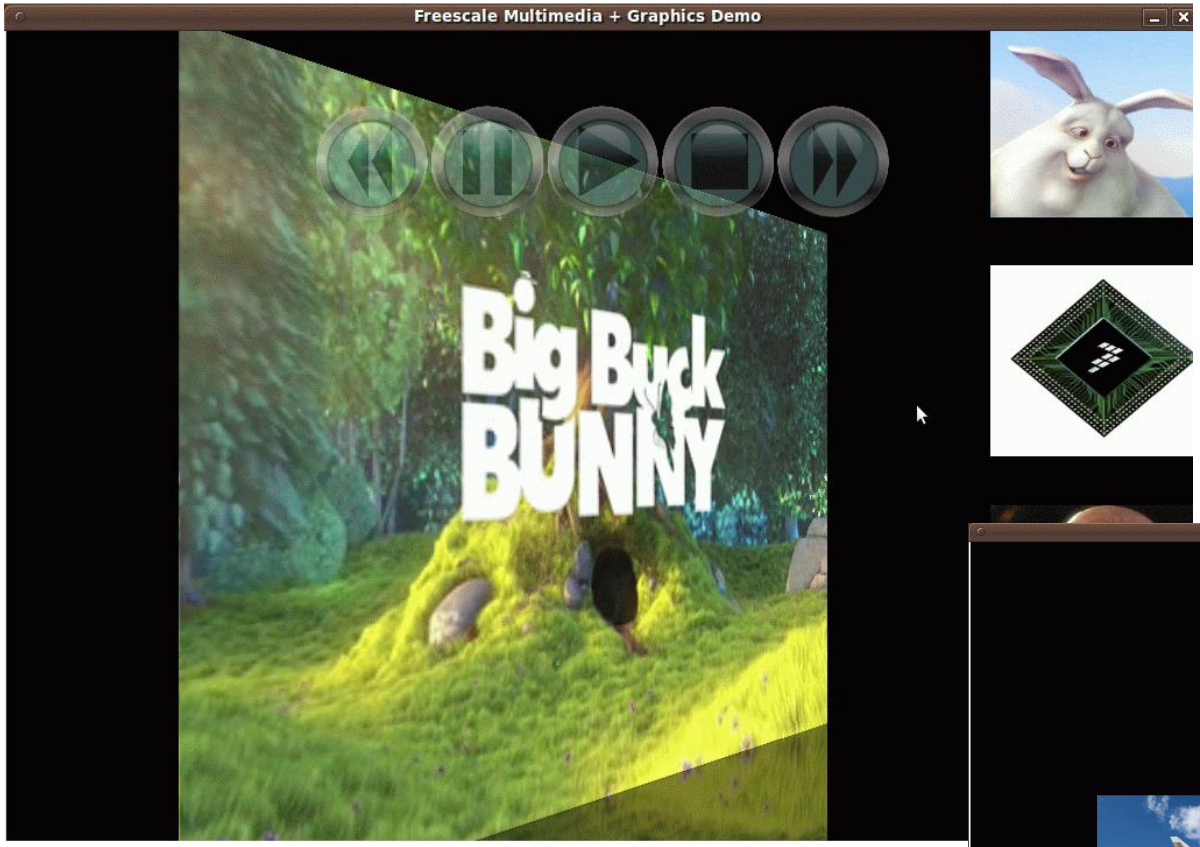
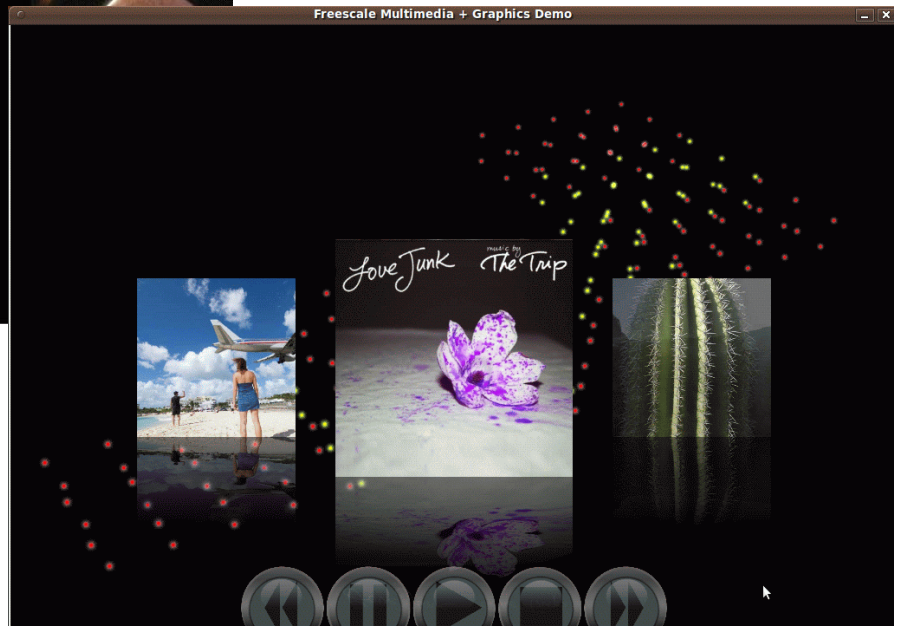
# 3D GUI
# Demo

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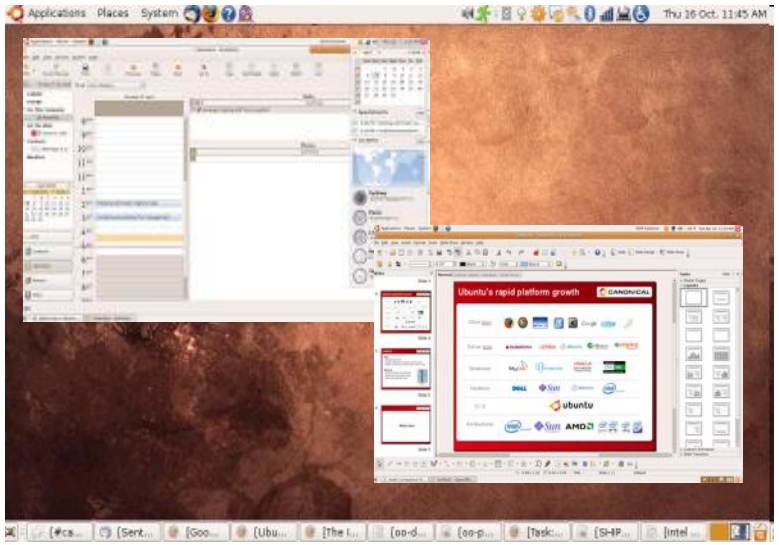
# Ubuntu Demo

- Full Desktop Support on i.MX515
  - Gnome-based desktop UI
  - Full open office support document, presentation and spreadsheet SW
  - Support for multiple browsers (including Opera, Mozilla, etc.)
  - Large pool of applications (instant messaging, etc.)
- Popular commercial Ubuntu Desktop Edition was released for ARM in April 2009
- Enablement of All-Day Computing devices



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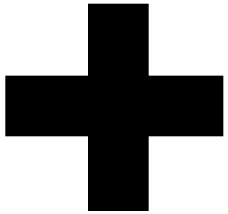
# Android Demo



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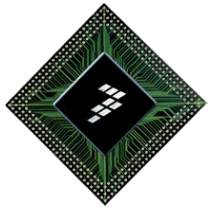

# Questions?

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